Solving the UK’s problems of productivity growth and regional economic disparities: the role of the chemicals industry

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How do we create value?

The Alchymist, In Search of the Philosopher’s Stone, Discovers Phosphorus, and prays for the successful Conclusion of his operation, as was the custom of the Ancient Chymical Astrologers.

Joseph Wright of Derby
How (and where) do we create value?

Plant (capital stock) | Labour | Science, technology, “know-how”, IP

Feedstocks & other inputs (cheap) | Products (valuable)

New Castle, DE, Croda's bio-ethylene oxide plant
The Solow growth model including technological progress

\[ Y(t) = F[K(t), L(t), A(t)] \]

Output \quad \text{Capital stock} \quad \text{Employment} \quad \text{“Level of technology”}

Growth Accounting

- Control the measured economic growth for changes in capital stock and labour inputs
- What’s left is called “total factor productivity”
- Interpreted by economists as a measure of “innovation”
- c.f. “Labour productivity” - output per hour of labour
Outline

• The UK’s productivity and regional imbalance problems
• Sources of productivity growth in the UK economy – how important are chemicals and pharmaceuticals?
• What should industrial policy focus on?
• The chemicals industry in a net-zero world
• (Why) Is R&D productivity falling?
• An industrial strategy for the chemicals industry
The UK’s productivity and regional imbalance problems
Economic growth has stalled – and this is reflected in stagnating living standards

UK labour productivity since 1970

1971-2005 trend: 2.3% pa growth
2009 - 2018 trend: 0.45% pa growth

UK average real wages

Data: ONS
(All data pre-COVID, of course)
Most of the UK is below average in wealth and productivity

Outside the SE, productivity levels are comparable with E. Germany or S. Italy

GVA per hour at NUTS 3 region level in 2014

Only three regions of the UK contribute to government more than they receive.

The difference between government revenue and current expenditure for NUTS1 regions, plotted against their regional productivity (GVA per person), both expressed per head of population. ONS data.
R&D spending is highly concentrated in London, E & SE

Public sector funding is more concentrated than private sector funding.

London, together with the two subregions containing Oxford and Cambridge, account for 46% of all public and charitable spending on R&D, with 21% of the UK’s population.

Sources of productivity growth in the UK economy
The UK's economic sectors, mapped by their contribution to the economy and historical total factor productivity performance.

Data from EU KLEMS Growth and Productivity Accounts database.

Total factor productivity growth in manufacturing sub-sectors

Manufacturing subsectors in the UK’, mapped by their contribution to the economy and historical total factor productivity performance.

Data from EU KLEMS Growth and Productivity Accounts database
Total factor productivity growth – manufacturing

- TFP growth in manufacturing was slower than the whole economy in the mid-1990’s.
- From ~1998 to the global financial crisis in 2008 manufacturing TFP grew faster than the economy as a whole.
- Since the GFC TFP of both manufacturing & whole economy have stagnated.
Total factor productivity growth – fast growing sectors

- TFP growth in finance boomed in the mid-90’s, peaked in 2007, and has fallen ever since
- A strong recovery in transport equipment (automotive & aerospace) accelerated from 2009 but shows signs of plateauing
Total factor productivity growth – pharma & chemicals

- Pharma showed strong TFP growth from late 90’s to 2009, fell deeply to 2013, & is making a partial recovery
- TFP in chemicals has shown steady increases over the whole period
Growth doesn’t happen in a balanced way across an economy, because technological progress is uneven

Not all technology is accelerating…

Since 1988 computer (CPU) power has increased by more than 3 orders of magnitude…

…but this is still the train to Manchester

Baumol’s “cost disease”

• Since the 18th century, steel making has achieved much higher productivity...

• But it takes much the same amount of labour to perform an opera to a live audience

• The result is that going to the opera has become much more expensive relative to buying nails.

• In general labour intensive services (e.g. arts, education, healthcare) become more expensive relative to manufactured goods
Baumol’s “cost disease” is not a disease!

• Wrong response is to think all that matters is improving productivity in services…
• Because it’s the greater purchasing power that productivity improvements in goods gives us that allows us to afford more services, even at their higher (relative) prices
• It’s the sectors with high productivity growth that pull along the whole economy
What should industrial policy focus on?

• “Vertical” industrial strategy - based around the specific needs of industry sectors – was out of fashion in the 80’s, 90’s & 00’s. This was a mistake.

• We’ve seen some return to sector-based industrial strategy since the global financial crisis – but the chemicals industry has been sidelined.

• What best fixes the UK’s problems of stagnant productivity and regional economic disparities?
  – Sectors with the high potential for productivity growth
  – Sectors that contribute to high productivity in economically underperforming parts of the country

• The chemicals industry qualifies on both counts.
The chemicals industry is concentrated outside the rich GSE

Location quotients for chemicals industry (SIC 20), 2015

GVA per head 2016
The chemicals industry in a net-zero world
What’s not included in the GVA figures

Some costs aren’t measured in money, & are born by the rest of society

Feedstocks & other inputs

Unsustainable feedstocks deplete natural capital

Costs of pollution & accidents born by nearby communities & ecosystems

High energy use produces carbon emissions & climate change

Environmental impact of improper disposal of products at end of life

Products

Contributing to new zero carbon & lower impact technologies

Products
The chemicals industry is a big energy user!

Emissions: 20% of manufacturing, 3% of total
Towards net zero: the UK’s domestic greenhouse gas emissions

- Export heavy industry
- Dash to gas
- 50% low carbon electricity through biomass, offshore wind & old nuclear

Fully decarbonize & expand electricity generation:
- More offshore wind
- New nuclear (?)
- CCS (?)

Storage
- Batteries
- Hydrogen (?)

Decarbonize industry:
- Hydrogen (?)

Decarbonize transport
- Electric vehicles
- Synthetic aviation fuel (?)

Decarbonise housing
- Net zero dwellings
- Hydrogen (?)
The net zero agenda is (largely) a chemicals industry agenda

Fully decarbonize & expand electricity generation:
• More offshore wind
• New nuclear (?)
• Carbon capture & storage (?)

Electricity storage
• Batteries
• Hydrogen (?)

Decarbonize industry:
• Hydrogen (?)

Decarbonize transport
• Electric vehicles/ batteries
• Hydrogen/ fuel cells (?)
• Synthetic aviation fuel (?)

Decarbonise housing
• Net zero dwellings
• Hydrogen (?)
What’s going to drive the chemicals industry

- Markets – and marketing
- The priorities of the massive economic system change that net zero demands
- Government interventions:
  - Regulation
  - Market making
  - Industrial strategy
- The global environment
(Why) Is R&D productivity falling?
By some measures, the output of the world’s scientific enterprise is increasing.

But are we seeing diminishing returns?

Are Ideas Getting Harder to Find?

Nicholas Bloom  
Stanford University and NBER

Charles I. Jones  
Stanford University and NBER

John Van Reenen  
MIT and NBER

Michael Webb*  
Stanford University

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Exponentially falling R&D productivity in pharma

Eroom’s law: the number of new molecules approved by the US Food and Drug Administration (pharma and biotech) per US$bn global R&D spending. (after Jack Scannell).
Can we drive up productivity in the R&D the chemicals industry needs?

The way we do research...

The kind of research we do...

Andy Cooper – lab automation

Dan Sarewitz on academic pathologies

https://www.nature.com/articles/s41586-020-2442-2

https://www.thenewatlantis.com/publications/saving-science
An industrial strategy for the chemicals industry
An industrial strategy for the chemicals industry

Productivity

• Towards the 2.4% R&D intensity target
• A science & innovation system that works
• Translational research & business/ academia links
• Regulation

An industrial strategy for the chemicals industry

Regional Growth

- Preserving and growing clusters
- Regional innovation systems
- Skills at all levels
An industrial strategy for the chemicals industry

Net Zero Challenges

• Recognising the scale of the economic transformation
• Setting the direction and getting on with it!
• Research and implementation need to be simultaneous, not sequential
Some concluding thoughts…

“Think global, act local”

The industry is a global industry
– But its activities take place in specific places
– Q is, why does this activity need to take place here?

Climate change is a global problem
– national governments have to lead
– And yet technological choices will be made emergently across the world
Thanks!

• For more on these issues:

“The Biomedical Bubble: Why UK research and innovation needs a greater diversity of priorities, politics, places and people”
Richard Jones & James Wilsdon, NESTA (2018)
https://www.nesta.org.uk/report/biomedical-bubble/

“A Resurgence of the Regions: rebuilding innovation capacity across the UK”.
http://www.softmachines.org/wordpress/?p=2340

“The Missing Four Billion: Making R&D work for the whole UK”
Tom Forth & Richard Jones, NESTA (2020)
https://www.nesta.org.uk/report/the-missing-4-billion/