

The position of the UK in the emerging green economy

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1 Introduction

The challenges posed by climate change and other pressing environmental issues demand a transition to a greener economy. The economic changes needed to tackle these problems are likely to require more than simply expanding the environmental goods and services sector. Rather, the creation of a green economy will affect not just a few sectors but the product mix and production processes of virtually the whole economy (Stern 2010). This will entail sectoral shifts and changes in comparative advantage that inevitably imply winners and losers. It is therefore crucial for governments to understand where each country stands in the emerging global green race. However, to date there is little evidence about who the winners of the global “green race” might be.

This paper aims to provide policy makers and other stakeholders in the UK with a clearer understanding of the strengths and weaknesses of sectors in the UK in the emerging green economy. It does this by applying a previously-developed framework¹ for measuring green competitiveness to data for 75 sectors in the UK. It compares the situation of the UK in these sectors to seven other countries: the Netherlands, China, France, Germany, Japan, South Korea and the United States.

We find that the overall performance of the UK in terms of green innovation is below average when compared to large innovative economies such as USA and Japan but also to close competitors such as Germany and emerging economies such as China and Korea. The UK has a relatively small number of sectors with a rapid rate of green conversion and a relatively large number of sectors with a slow rate of green innovation. The UK enjoys a strong green competitive position in several sectors, but these are sectors of small economic size, such as chemical products and prepared animal feeds. Some sectors present a clear opportunity to maintain and expand market share in the future through greening, in particular refined petroleum products and basic iron and steel. However, several other sectors stand out as having a strong present-day comparative advantage that

¹ Fankhauser, F, A Bowen, R Calel, A Dechezlepretre, D Grover and M Sato (2013) 'Who will win the green race? In search of environmental competitiveness and innovation,' forthcoming in *Global Environmental Change*.

may be at risk by an inadequately fast rate of green conversion. Of particular concern is the aircraft and spacecraft sector.

2 Analytical framework

Extending the work of Fankhauser et al (2013) to the UK, we measure a sector's green competitiveness through three distinct indicators of this concept: (1) the current comparative advantage of the sector in global trade, (2) the current amount of green innovation activity in the sector, and (3) the current size of the sector in terms of output. Comparative advantage in global trade measures current sector performance while green innovation is taken as a barometer for competitiveness in the future green economy. We then combine the three indicators through descriptive statistics and graphical analysis, and identify which sectors in the UK are likely to be 'leaders' and 'laggards' in the emerging green economy.

2.1 Current comparative advantage

The current comparative advantage of a sector in a country is measured with a revealed comparative advantage (RCA) index. The RCA index measures the comparative advantage or disadvantage of each country-sector in global trade. It is commonly referred to as the Balassa index (Balassa, 1965). The value of the index for each country sector is given by:

$$RCA_{is} = \frac{e_{is}}{\sum_s e_{is}} / \frac{\sum_i e_{is}}{\sum_s \sum_i e_{is}}$$

where RCA is the index value calculated for each country i and sector s . The numerator measures the share of exports in a country-sector relative to total exports from that country. The denominator is the share of exports by the sector globally relative to total exports globally, for all countries in the sample. The index effectively captures a country-sector's comparative (dis)advantage *relative to the other countries in the sample*. The index is calculated using international trade data from the United Nations (Comtrade), *excluding re-exports*.

2.2 Green innovation index

The green innovation index (GII) is the second green competitiveness indicator. It measures the speed at which the greening of the sector is taking place. It captures, for example, how quickly technological progress is leading renewables to overtake conventional generation in the electric power sector. Measuring the rate of greening in this way is consistent with the view that ‘creative destruction’ is the engine of transformative growth (Dosi et al 1988; Malerba 2007). As with the RCA index the green innovation index produces a value for each country-sector:

$$GII_{is} = \frac{p_{is}^G}{p_{is}} / \sum_i \frac{p_{is}^G}{p_{is}}$$

On the right-hand side p_{is}^G captures the number of green patents and p_{is} captures the total number of patents in country i , sector s . This is put into proportion, in the denominator, with the proportion of green patenting to all patenting for all countries in the sample. Normalising in this way against broader patenting activity is important because it corrects for idiosyncrasies in patenting behaviour in particular sectors or countries. Indeed, evidence shows that the propensity to patent differs widely across sectors (Cohen et al. 2000). The index is based on a dataset that describes patenting activity by over 450,000 firms worldwide (see Fankhauser et al., 2013, for details). The advantages and limitations of patent data as a measure of innovation have been described at length in the literature (see OECD, 2009, for a recent overview). For our purpose, there are two main advantages. First, they are available at a highly technologically disaggregated level, which allows us to distinguish clean and non-clean innovations in a very precise way. For example, we can identify innovations related to electric, hybrid and hydrogen vehicles in the auto industry. R&D investment cannot be disaggregated in such a way. Second, although patents are typically used more by large companies, R&D is usually not reported at all for small and medium sized firms. However, readers should keep in mind that only a small share of companies use patents as a means of protection against imitation. In a small

economy like the UK, this means that the number of patents on which our statistics are based might be small in some sectors. Hence, we caution against inferring too much of our results in sectors with overall small patenting activity.

2.3 Sector size

Sector size measures the current importance of the sector to the country's economy, in absolute terms, based on data come from the United Nations Industrial Statistics database. Although we expect that the relative size of sectors within a country will shift and change as a greener economy emerges, we use current sector size as a proxy for how important the sector might be in the future. The assumption here is that current output is correlated with future output. Indeed, rather than a simple expansion of a country's present-day environmental goods and services sector (BIS 2011; EBI 2012; ECORYS 2009; Ernst & Young 2008), we expect each sector to become progressively greener 'from within' through production process changes (e.g. producing electricity with renewables rather than with coal) and through a shift toward producing cleaner final goods (e.g. low-emissions vehicles taking the place of petrol-fuelled vehicles in automobile manufacturing).

3 Application to the UK's manufacturing sector

We now apply the framework to UK data and contrast the performance of sectors in the UK against international competitors.

3.1 Country-level analysis

We start by providing a graphical analysis of the position of the UK as a whole against its main competitors. In the following bubble charts, the comparative advantage and the green innovation indexes run along the chart axes and provide the basis for establishing a sector's green growth potential. The size of the bubbles reflects the size of the sectors, which conveys the sector's future importance. For both the RCA and the GII, the data have been scaled in such a

way that the sample average across countries is one.² Therefore, if a sector scores between zero and one this indicates below-average performance; if a sector scores above one, this indicates above average performance. Figure 1 provides an example bubble chart.

Generally speaking, green competitiveness increases as one moves to the top and right of the chart.

- Sectors in the top-right quadrant currently enjoy a comparative advantage and are also performing well in terms of green innovation. These sectors are thus likely to perform well in the future green economy.
- At the other end, sectors in the bottom-left quadrant currently enjoy no comparative advantage and are performing badly in terms of green innovation. They are the obvious weak sectors.
- Sectors in the bottom-right corner currently enjoy a comparative advantage, but are not converting to the green economy. Therefore their current positions might be threatened as greener growth emerges.
- Sectors in the upper-left corner do not currently enjoy a comparative advantage. However, their current strong performance in terms of green innovation suggests that they could well become winners in a greener economy. From an industrial policy point of view, we suggest that some of the best competitiveness opportunities for the UK lie in this quadrant.

² For presentational purposes, the scales for both the RCA index (x-axis) and the GII index (y-axis) are adjusted to make the distributions (which are right-skewed) appear symmetric.

Figure 1: Interpretation of sector green comparative advantage

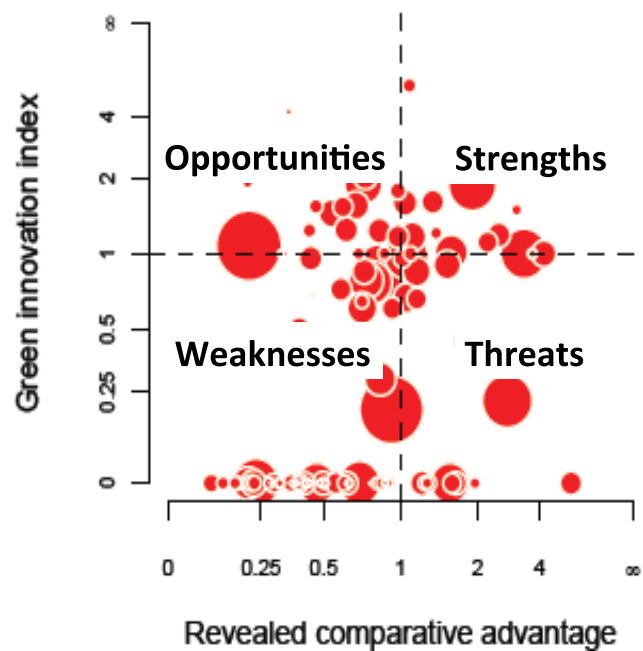


Figure 2 graphically analyses green competitiveness of the UK against its competitor countries. For clarity it depicts only the 15 biggest sectors in each country. Bubbles in the upper right hand quadrant indicate green competitive strength, bubbles in the lower left hand quadrant indicate green competitive weakness, and the size of the bubble indicates sector importance to the country. Figure 3 depicts the position of all sectors.

Overall, the UK's position is comparable to that of France and the Netherlands. In Europe, the UK is clearly outpaced by Germany, which is a traditional leader in clean technologies. It is clear from these figures that Japan, Korea and – perhaps surprisingly so – the US are best positioned to lead in the green race. Importantly, China has strong levels of green innovation in sectors in which it currently does not enjoy a comparative advantage, suggesting it could be well positioned in these sectors to compete with the UK in a future green economy.

The graphical analysis shows that the UK enjoys a strong green competitive position in none of its largest 15 sectors. When considering all sectors, one does find a few sectors in this area though, but these are sectors of small economic size, for example chemical products and prepared animal feeds. Two sectors among the top 15 in terms of output lie in the upper-left quadrant: Manufacture of refined petroleum products (ISIC 2320) and Manufacture of basic iron and

steel and of ferro-alloys (ISIC 2710). According to our categorisation, these two sectors represent opportunities for the UK in a greener economy. What is striking, however, is the high proportion of UK top sectors in the bottom-right quadrant of the chart. These sectors enjoy a strong comparative advantage but this position could be put at risk by a slow green innovation activity. These sectors include Manufacture of motor vehicles (ISIC 3410) and Manufacture of aircraft and spacecraft related machinery (ISIC 3530).

To sum up, the UK's performance in the green economy appears as below-average, with a few sectors of relatively small economic size doing well in terms of green innovation, but many sectors lagging behind, in particular sectors that currently enjoy a strong comparative advantage and could thus be at risk in an emerging green economy. The position of the UK appears similar in this respect to that of France and the Netherlands.

Figure 2: UK's position against competitor countries (15 biggest sectors)

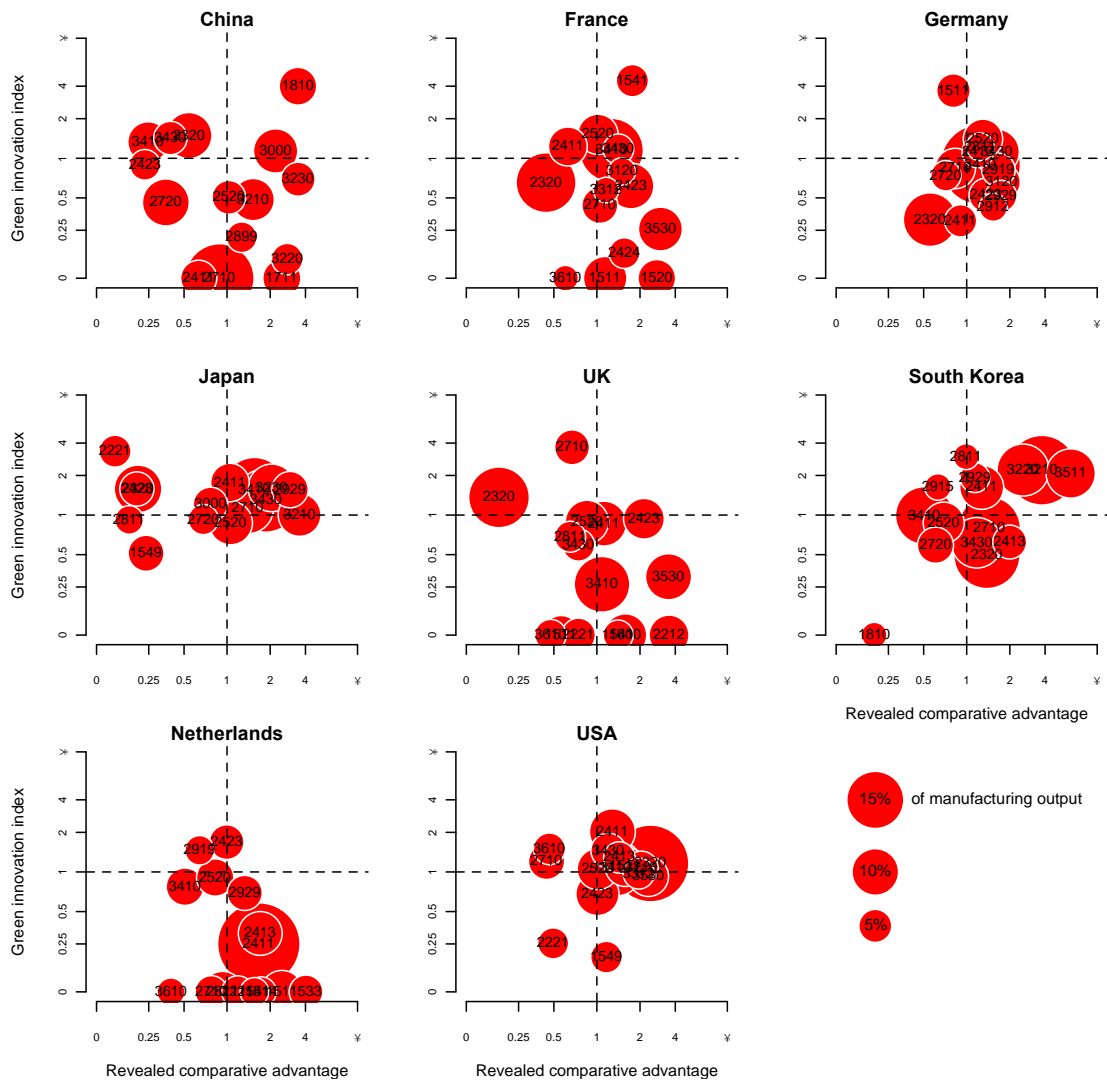
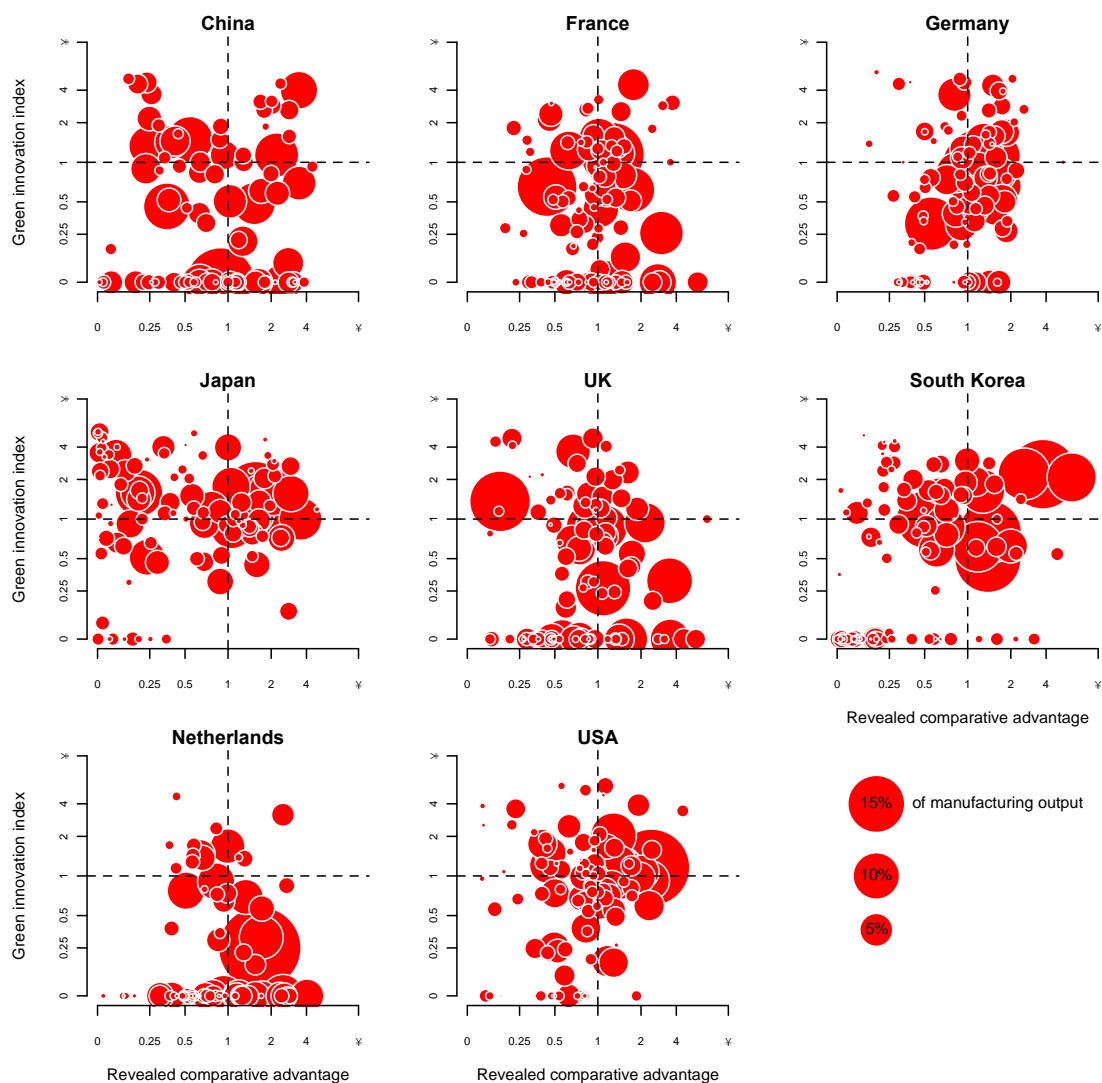


Figure 3: UK's position against competitor countries (all sectors)



3.2 Sector analysis

The data can also be arranged to show which countries enjoy a green competitive advantage within the sectors the UK might consider to be priority sectors. In Figure 5, we explore eight of these sectors: aircraft and spacecraft related machinery; steam generators; motor vehicles; domestic appliances; engines and turbines; electricity distribution; electric motors; and batteries. Note that for presentational purposes, the size of bubbles in Figure 4 represents the size of the sector in each country *relative* to the size of the sector worldwide – so that sectors that are globally small do not appear as tiny dots.

Figure 4: the UK's position in selected sectors (comparison against competitor countries)

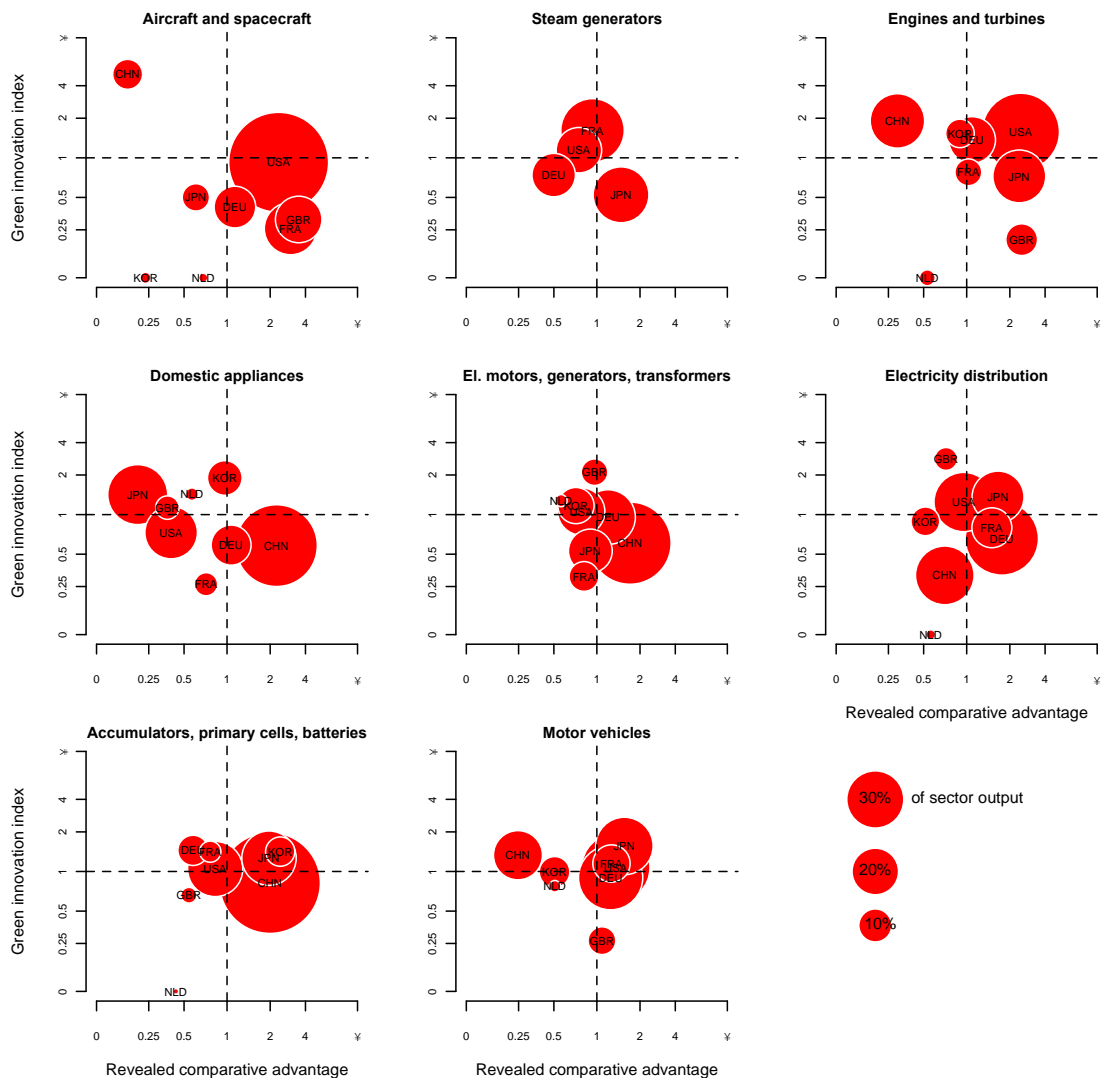


Figure 4 shows that the UK has a strong green innovation performance in electric motors and electricity distribution. There are opportunities for UK companies in these sectors. In the other six sectors, the performance of the UK is below average (and non-existent in steam generators). This could create a threat for UK businesses, particularly in aircraft and spacecraft machinery in which the country currently enjoys a strong comparative advantage.

4 Conclusion

This paper extends the analysis in Fankhauser et al (2013) to consider the competitive position of the UK in the emerging green economy. Overall, we find that the UK enjoys a below-average position globally with respect to green innovation. While the UK currently enjoys a comparative advantage across a wide range of sectors, a relatively small number of these sectors are greening at a rapid rate. The UK is positioned to fare well in the green economy in a number of sectors – including chemical products and prepared animal feeds – but these only represent a very small share of the UK’s economy. Several sectors are putting their present-day comparative advantage at risk by a sluggish green innovation activity. These include the aircraft and spacecraft machinery sector, which deserves particular attention because of their relatively large size and therefore importance within the UK economy. Importantly, some sectors present a clear opportunity to maintain and expand market share in the future through greening, in particular refined petroleum products and basic iron and steel.

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