



Who will win the green race? In search of environmental competitiveness and innovation[☆]



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ABSTRACT

As the world considers greener forms of economic growth, countries and sectors are beginning to position themselves for the emerging green economy. This paper combines patent data with international trade and output data in order to investigate who the winners of this “green race” might be. The analysis covers 110 manufacturing sectors in eight countries (China, Germany, France, Italy, Japan, South Korea, UK and the US) using data for the period 2005–2007. We identify three success factors for green competitiveness at the sector level: the speed at which sectors convert to green products and processes (measured by green innovation), their ability to gain and maintain market share (measured by existing comparative advantages) and a favourable starting point (measured by current output). We find that the green race is likely to alter the present competitiveness landscape. Many incumbent country-sectors with strong comparative advantages today lag behind in terms of green conversion, suggesting that they could lose their competitive edge. Japan, and to a lesser extent Germany, appear best placed to benefit from the green economy, while other European countries (Italy in particular) could fall behind. However, the green economy is much broader than the few flagship sectors on which the debate tends to focus, and each country has its niches of green competitiveness.

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1. Introduction

Policy-makers increasingly place economic growth at the centre of discussions over environmental management. They would like environmental policy to bring much-needed jobs, new technologies and competitiveness to domestic industry, as well as to protect the environment. Creating new market opportunities is an explicit objective of green growth policies in Europe (European Commission, 2012). China is promoting seven strategic industries (including, among others, clean energy, environmental protection and clean cars) that it hopes will place it at the forefront of green growth (Stern, 2010, 2011). South Korea, too, has made green growth a strategic priority (Ministry of Government Legislation, 2010).

This vision is supported by the emerging “green growth” literature. Counterbalancing calls for de-growth (Jackson, 2009;

Martínez-Alier et al., 2010), proponents of green growth assert that environmental stewardship is no impediment to economic prosperity, and may in some cases be a spur to growth (Bowen and Fankhauser, 2011; World Bank, 2012; Jacobs, 2013). Yet, the factors that affect the potential of environmental policy to improve competitiveness are poorly understood. And, perhaps as a consequence, there is little evidence about who the winners of the global “green race” might be.

This study contributes both to the conceptual understanding and to the empirical discussion of green competitiveness. We present an analytical framework based on decomposition analysis that can help to structure a discussion that has so far lacked a consistent analytical foundation. The framework identifies three success factors for green competitiveness at the sector level: the speed at which sectors may convert to green products and processes (measured by green innovation), their ability to gain and maintain market share (measured by existing comparative advantages) and a favourable starting point (measured by current output). We apply this framework to 110 manufacturing sectors of eight major economies, based on a large data set that combines patenting activity by over 127,000 firms with international sector-level trade and output data. Our analysis covers China, France, Germany, Italy, Japan, South Korea, the UK and the United States.

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We find that the green race is likely to alter the present competitiveness landscape. Several incumbent country-sectors with strong comparative advantages today lag behind in terms of green conversion, suggesting that they might lose their competitive edge. Manufacturers in Japan, and to a lesser extent Germany, appear best placed to benefit from the green economy, while those in other European countries (Italy in particular) could fall behind. However, the green economy is much broader than the few flagship sectors on which the debate tends to focus, and each country has its niches of green competitiveness.

Our *sector-level* analysis relates to a long-running debate about the link between competitiveness and environmental performance at the *level of firms* (Porter, 1991; Porter and van der Linde, 1995; Reinhardt, 1999; Esty and Winston, 2009). The empirical evidence from the firm-level literature is not always conclusive. For example, Martin et al. (2011) find that climate-friendly management practices are associated with lower energy intensity and higher productivity. Becker and Shadbegian (2009) in contrast find that ‘green’ manufacturing firms do not systematically outperform ‘non-green’ manufacturers on indicators such as survival, export growth, employment growth and productivity, although they pay higher wages.

There is also a debate about the role of industrial policy in shaping the green economy. Some authors see a need for industrial policy due to information externalities (e.g. Hausmann and Rodrik, 2003). Others argue that the information constraints on policy-makers are prohibitive and that industrial policy has played only a minor part in recent industrial successes (Pack and Saggi, 2006). What is clear is that business interest in the green economy depends on good and consistent public policy. Sound environmental policies (e.g. a price on carbon) with long-term credibility are essential to correct basic market failures and give environmental services a monetary value (Costantini and Crespi, 2008; Fankhauser, 2012; Kennett and Steenblik, 2005). Without them business interest soon dries up.

We do not aim to add to the industrial policy or innovation debate in this paper, and indeed we would caution against trying to infer too many policy implications from our findings. Our aim is simpler and more descriptive: To add to the understanding of green competitiveness at the sector level, focusing (somewhat narrowly) on manufacturing. This is a question of considerable interest to policy makers, as a series of policy reports and country performance rankings attest (e.g. Ernst and Young, 2008; ECORYS, 2009; Henderson et al., 2013; Pew, 2010; WWF, 2012). However, at the sector-level a rigorous assessment based on a clear analytical framework has so far been lacking. We also assemble a detailed new dataset that can help with further research in this area.

The paper is structured as follows. The next section outlines the analytical framework that underpins our analysis. In Section 3, we present the data and introduce proxies for the three factors we use to assess green competitiveness. Section 4 presents results for the eight countries we consider and some key manufacturing sectors. Section 5 concludes.

2. Understanding green competitiveness

2.1. What is a green economy?

There is an established tradition of measuring the contribution to GDP of the environmental goods and services sector. In the definition of the OECD, environmental goods and services include all activities that measure, prevent, limit, minimise or correct environmental damage (OECD, 1998). Other definitions vary (Steenblik, 2004), as do numerical estimates, but it is clear that according to this delineation the green economy is worth several

hundred billion, and perhaps several trillion, US dollars a year globally (EBI, 2012; ECORYS, 2012; BIS, 2011).

Yet, for many of its proponents green growth is about something more radical (Bowen and Fankhauser, 2011; Jacobs, 2013). Green growth advocates do not see environmental management as just another economic sector alongside conventional activity. They argue that the economic changes required to combat problems like climate change are not marginal, as most traditional models suggest, but transformative and system-wide (Perez, 2010; Stern, 2010). The creation of a green economy will therefore affect not just a few sectors but the product mix and production processes of virtually the whole economy.

Consistent with this literature, we interpret green growth as an economy-wide transformation, rather than the expansion of the environmental goods and services sector. We are equally interested in the structural changes within a sector (say, the emergence of low-emissions technology in car manufacturing) as in the expansion of one sector (such as solar panel production) at the expense of another (such as coal mining).

The idea of countries competing for market share in an emerging green economy is rooted in our understanding of the organic, bottom-up dynamics of national and sectoral innovation systems (Archibugi et al., 1999; Dosi et al., 1988; Malebra, 2002). Systems of innovation are distinct networks of public and private institution within countries and sectors that initiate, coordinate, import, modify and diffuse new technologies. Innovation systems may explain why some sectors excel at adapting to and exploiting the opportunities presented by a green economy. Our expectation is that differences across innovation systems will reveal large differences in the responsiveness of sectors and countries to the opportunities in the emerging green economy.

The competitiveness literature suggests that green competitiveness is most likely to be derived from existing comparative advantages, skills and production patterns (Hidalgo et al., 2007; Hausmann and Hidalgo, 2010). For example, Germany developed a comparative advantage in wind turbines on the back of its existing expertise in high-precision machining (Huberty et al., 2011). We therefore treat existing capabilities as a key indicator of future comparative advantage in the green economy. This does not preclude market entry and exit at firm level. The idea of ‘creative destruction’, where new firms and new ideas drive out the old (Schumpeter, 1942), is central to the type of transformative growth that the green economy discourse espouses (see also Aghion and Howitt, 1998, 2009; Dosi et al., 1988; Malebra, 2002; Oltra and Saint Jean, 2009; Perez, 2002).

Structural change of this scale will create both winners and losers. Some economic activities will be scaled back, and if there are rigidities in relative wages, skills and production techniques, this will lead to a temporary drop in output and employment (Babiker and Eckaus, 2007). At the same time, the rewards could be massive for the winners of the “green race”, which obtain a comparative advantage in environmentally benign products and processes.

Although they are used here, terms like “race”, “comparative advantage” and “competitiveness” should be interpreted with caution (as famously argued by Krugman, 1994). Firms are competitive if they offer products and services that are in demand in the market place (e.g. because they are cheaper or of superior quality). Countries gain a comparative advantage (and specialise) in areas where they can produce with lower opportunity costs relative to others. But the notion of a race between countries, or competitiveness at the country level, is misleading (Voituriez and Balmer, 2012). What ultimately matters at the national level are real incomes and productivity. The countries that develop a comparative advantage in greener goods and services will benefit

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