Research Policy 39 (2010) 687–697

Contents lists available at ScienceDirect

Research Policy

journal homepage: www.elsevier.com/locate/respol

The role of ICT knowledge flows for international market share dynamics

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ARTICLE INFO

Article history:
Received 27 February 2007
Received in revised form 1 February 2010
Accepted 2 February 2010
Available online 6 March 2010

JEL classification:
C23
F14
O31

Keywords:
ICT
Export shares
National knowledge flows
International knowledge flows
Bibliometric data

ABSTRACT

This paper investigates the role of Information and Communication Technologies (ICTs) related knowledge flows for international market shares. Using bibliometric data on scientific publications, we analyse the relationship between the strength of 14 OECD countries in four ICT-related scientific fields and the ability of those countries to maintain and acquire export market shares in the OECD market, across 16 manufacturing industries over the period 1981–2003. We find that domestic and foreign ICT-related scientific knowledge flows have a positive and significant impact on export market shares in ICT industries, while only domestic flows positively affect export shares in non-ICT industries. We also find that small open economies benefit more than other countries from foreign knowledge flows both in ICT and in non-ICT industries.

1. Introduction

International competitiveness is generally understood to refer to "the ability of a country to expand its [market] shares in domestic and world markets" (Magnier and Toujas-Bernate, 1994: 495, our insert in brackets). Such competitiveness of nations continues to be a concern for people working in academia (e.g., Leon-Ledesma, 2005) and for policy-makers (e.g., Obama and Biden, 2008). Even though many academic papers have been written about the drivers of international competitiveness, we still need to know much more about what determines it. Although few would deny the importance of standard price factors in affecting competitiveness or export market shares, there is an emerging consensus in the literature that non-price factors – particularly those related to technology – are a major determinant (e.g., Fagerberg, 1988; Amendola et al., 1993; Magnier and Toujas-Bernate, 1994; Amable and Verspagen, 1995; Carlin et al., 2001; Montobbio, 2003). In general, studies that look at the technology factor have relied on "own-industry" technological activities, typically measured as research and development (R&D) spending or patenting activity.

Recently, attempts have been made to incorporate technological flows (or "spillovers")[1] in models of international market share dynamics either by looking at embodied R&D flows between industries (Fagerberg, 1997; Laursen and Meliciani, 2000; Laursen and Meliciani, 2002) or by estimating the effect of national and international knowledge stocks for trade performance (Gustavsson et al., 1999; Leon-Ledesma, 2005). Although there are not many papers looking at such flows, the ones that exist have generally found support for the idea that intra-industry and inter-industry domestic knowledge flows matter for international export market shares, while the support for the importance of international knowledge flows, in this context, is much more limited. However – to our knowledge – no paper exists which looks at the role of national and international ICT knowledge flows in determining competitiveness while attempting to trace actual interactions between countries. Information and Communication Technologies (ICTs) have become centrally important in many industries of the economy and have

[1] While spillovers – in this and other contexts – are difficult to distinguish empirically from knowledge flows (as they both involve science–industry transactions), in our view there are at least two conceptual differences. First, knowledge flows, as opposed to spillovers, do not necessarily involve externalities; and second, they are consistent with a two-way interaction between actors rather than involving the one-way transfer of technology from one actor to another. In this paper, we adopt the notion of knowledge flows.

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doi:10.1016/j.respol.2010.02.007

a growing impact on the organisation of economic activity, due to the ample range of applications of the technologies. Moreover, in terms of types of technology diffused within and across nations, the ICT industries are the main sources of technology acquired in most developed countries (Papaconstantinou et al., 1998). However, capturing the importance and impacts of ICTs is always not straightforward (OECD, 2005). We combine research on the impact of technology on international economic performance with the bibliometric approach pertaining to the localized geographical reach of the benefits of scientific research (e.g., Jaffe et al., 1993; Hicks et al., 1994; Audretsch and Feldman, 1996; Agrawal and Cockburn, 2003).[2] More specifically, this paper is concerned with the importance of national and international science-based ICT knowledge flows for the ability of OECD countries to maintain or acquire export market shares at the industry level.

The basic idea is to use the science-production relevance matrix, constructed by Laursen and Salter (2005). Based on publications by private business firms, the relevance of four ICT-related scientific fields for 16 manufacturing industries is conjectured. The procedure hinges on the assumption that when firms in particular industries publish papers in particular fields of science then they do it – at least partly – because they have, and wish to maintain, an "absorptive capacity" in the relevant scientific fields. In other words, we assume that firms from an industry that publishes in some fields will make use of knowledge developed within the same fields. Using this relevance scheme, we analyse the relationship between the strength of 14 OECD countries in four ICT-related scientific fields and the ability of those countries to maintain and acquire export market shares in the OECD market, across 16 manufacturing industries over the period 1981–2003. Among other variables, unit labour costs, the exchange rate and "own industry" technological activity are controlled for, while using a dynamic panel data model. The data used for the study are drawn from the ISI National Indicators, SPRU BESST, US Patent Office and from the OECD STAN databases.

The idea of the present paper is not only to look at domestic sources of ICT-related knowledge, but also to try to assess the importance of international scientific knowledge flows in ICTs for the ability of OECD countries to maintain or acquire market shares at the 16 industry level. However, for calculating such flows of international scientific knowledge, country-level weights are needed in order to determine the importance of each country as a knowledge source to any of the other countries in the analysis. In this context we are using data on international co-publications in ICT fields of science across 23 partner countries. The key assumption here is that the more the scientists of a given country collaborate with scientists of another country, the more is drawn from the science-base of the foreign country.

The main findings of the paper support the important role played by both domestic and foreign ICT-knowledge flows for international market share dynamics. However, we also find that the importance of such flows varies across industries (ICT and non-ICT industries) and across countries. In particular, small open economies benefit significantly more than other countries from foreign knowledge flows.

The paper is structured as follows. Section 2 contains a discussion of the existing theoretical and empirical literature on the role of technology and ICT-related knowledge flows for competitiveness. Section 3 describes the data and the construction of the knowledge flow variables, while Section 4 depicts the empirical specification and econometric methodology. In Section 5 our estimations are presented and discussed. Finally, Section 6 concludes.

2. The role of ICT-related knowledge flows for international market shares

2.1. Theory

In the standard specification, the quantity of export demand is modelled as a function of three factors: the level of income in the importing region; the price of the imported good; and the price of domestic substitutes (Goldstein and Khan, 1978; Magnier and Toujas-Bernate, 1994; Leon-Ledesma, 2005). Accordingly, one would expect relative prices to be a central determinant. However, the well-known "Kaldor paradox" is based on the finding (Kaldor, 1978) that the fastest growing countries in terms of exports shares also experienced the highest rise in unit labour costs. Although later research (e.g., Magnier and Toujas-Bernate, 1994; Laursen and Meliciani, 2000; Carlin et al., 2001) has shown that unit labour costs can help explain export shares with the expected negative sign, relative prices – as proxied by unit labour costs – are far from being able to explain a lion share of countries export shares in most industries. In the standard literature, other non-price influences are lumped together in the income elasticises of imports and exports. Here, a higher than average income elasticity of exports implies that a country will benefit more than others from growth of world income.

The determinants of this elasticity may, however, be many (McCombie and Thirlwall, 1995), but common to most of them is that they are based on technological advantages as a result of investments in R&D. It may reflect the commodity composition of the vector of exports, as some industries experience higher than average demand growth, as income increases. In particular, high-tech products typically have a higher than average demand growth (Amable and Verspagen, 1995). In this paper, however, we focus on drivers of international export competitiveness at the industry-level, so we can discount this effect. More pertinent to this paper, the elasticity may also reflect the quality of the exported goods; either/or in terms of a higher reliability of the goods or in terms of the new and better features resulting from product innovations, so that countries with superior products gain market share over other countries. A supply-side explanation (Krugman, 1989, p. 1039) pertains to the possibility that fast growing countries expand their export market shares, not by reducing their relative prices, but by expanding the range of goods they produce as their economies grow. Although Krugman does not seriously endogenise product variety (it is assumed to be proportional to the labour force), it is likely to be a function of investments in innovation (Leon-Ledesma, 2005). All of these mechanisms suggest that a given country's level of technology should affect the country's market share in terms of gains or losses. As mentioned in the introduction to this paper, there is plenty of empirical support to back up this claim.

Recently, theoretical and empirical models have begun to incorporate international knowledge flows as determinants of export performance. Since technology can be nationally produced or available through international knowledge flows, the export demand function will also depend on the national and international stock of knowledge. Provided the arguments concerning the expected positive effect of national knowledge leading to increased exports, the impact of foreign knowledge is ambiguous (Leon-Ledesma, 2005). There is a negative effect: an increase in foreign knowledge increases the market share of foreign firms reducing national exports. However, there is also a positive effect: an increase in foreign knowledge may increase knowledge flows and may hence

[2] Note that although we look at science-based knowledge flows, based on scientific journal publication, this does not imply that all of this research is produced at universities. To be sure, employees of private firms often publish in scientific journals, also in the field of ICT (see, Rosenberg, 1990).