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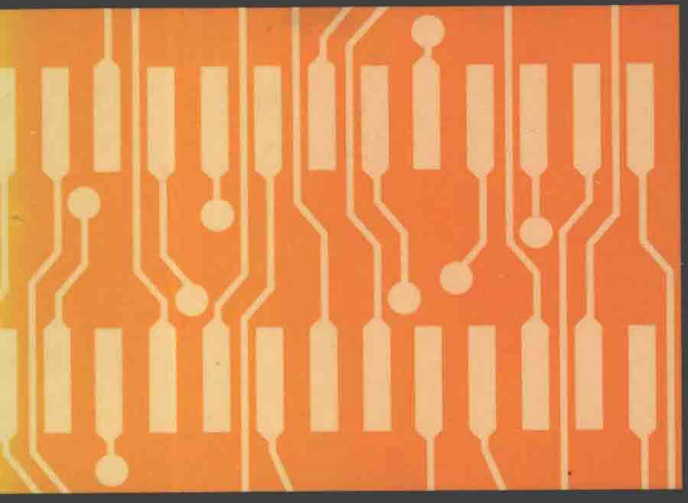
Technology AND International Trade



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Preface

The chapters in this book were originally presented at a conference on 'Technology and International Trade', initiated by the Norwegian Institute for International Affairs (NUPI) and the Trade Union Institute for Economic Research (FIEF), at Leangkollen, Oslo, in October 1995. We, the organizers of the conference and the editors of this book, wish to thank the authors for their patience with the continuous harassment from editors and referees and for their ability to produce revised versions within a very tight time schedule. Thanks are also due to a number of referees who greatly facilitated our editorial task, to Liv Høivik for handling the practical matters concerning the conference and to Jimmy Miller for checking the language. Finally we wish to express our gratitude to the Nordic Council for Economic Research (NEF), the Nordic Academy for Research Education (NorFA) and the Norwegian Research Council (NFR) for their generous financial support.

Jan Fagerberg
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Oslo and Stockholm, March 1996

Introduction

The last decades have witnessed important changes in global trade patterns. The market shares of Japan and other fast-growing countries in Asia have increased at the expense of other countries. At the same time many European countries face sluggish growth and increasing unemployment. These developments have led to an increased awareness among policy-makers, media and researchers of factors affecting competitiveness and employment. Increasingly, many observers have come to stress the importance of technology in this context. For instance, this view has figured prominently in recent policy debates within the European Union.

The objective of this book is to contribute to the understanding of the relationships between technology, competitiveness, trade, employment and growth. The book includes theoretical as well as empirical work, applying different perspectives. The first half of the book – Chapters 1 to 6 – addresses the general issue of the determinants of competitiveness and specialization. Of these, Chapters 1, 2, 3 and 4 focus on the impact of technology on international competitiveness. Chapters 3 and 5 study the role of domestic market size. The consequences of technological progress in the form of learning for specialization are analysed in Chapter 6, while Chapter 7 reviews the literature on trade (openness) and growth. Chapters 3, 8 and 9 focus on national and international flows of technology and the role of multinational firms for the localization of R&D. Chapters 10 and 11 analyse the policy options in open, innovation-driven economies. Finally, Chapters 4 and 12 assess the impact of technology on labour markets.

The idea that technological differences, or differences in productivity, across countries explain specialization patterns is not a new one. In fact, this was the starting point of the most influential trade theorist of all times, David Ricardo. For most of this century, however, theoretical and empirical studies of trade patterns have been dominated by another paradigm, the factor proportions or Heckscher–Ohlin theory, named after the two Swedish economists Eli Heckscher and Bertil Ohlin. According to this theory, comparative advantage is determined not by technology gaps, but by the unequal distribution across countries of various (immobile) factors of production.

The role of technology for competitiveness was never completely neglected. The effects on trade patterns and specialization of factor accumulation and

(exogenous) technical change and technology gaps were studied by Johnson (1959) and Jones (1965) within the framework of the traditional factor proportions theory. Basically this approach treated the R&D efforts of a country as an additional resource or 'endowment'. Moreover, some early empirical studies (for example, Gruber, Metha and Vernon, 1967) included measures of technological requirements such as R&D expenditure together with factor proportions variables to explain trade patterns.

However, it is probably fair to say that technology came to the forefront of research in international trade with the formulation of the technology gap and product-cycle theories (Posner, 1961; Vernon, 1966; Hirsch, 1967). Posner's theory was based on the idea that manmade differences in technological capabilities across countries induce trade. Vernon and Hirsch assumed that the competitive conditions of an industry, and hence the factors affecting competitiveness, change through time. The rich countries (the North) were assumed to specialize in the early phases of the life cycle, in which innovation matters most. But as the industry matured the North would be outperformed by the imitating South, exploiting cost advantages. The lessons for the rich part of the world were summarized by Paul Krugman (1990, p. 147): 'Like Alice and the Red Queen, the developed region must keep running to stay in the same place'.

The technology gap and product-cycle theories have been a source of inspiration for later theoretical and applied work ever since (for surveys of empirical work, see Deardorff, 1984 and Leamer, 1994). One strand of research analyses technology gaps in the international economy from an evolutionary or Schumpeterian perspective (Dosi, Pavitt and Soete, 1990). Another, based on so-called 'new trade theory', focuses on the role of economies of scale (another classical idea, generally attributed to Adam Smith) and externalities as a source of technology gaps and specialization (Krugman, 1990). More recently, growth theorists have extended this perspective by suggesting models in which the creation of technology gaps has been endogenized (so-called 'new growth theory', see Grossman and Helpman, 1991).

In this book, the four empirical chapters evaluating the role of technology for competitiveness and trade all basically have the Ricardian, or technology gap, approach as the point of departure. While Fagerberg (Chapter 3) uses an input measure – R&D expenditure – of investments in new technology, Wolff (Chapter 1) and Gustavsson, Hansson and Lundberg (Chapter 2) focus on the output from these investments, as reflected in the 'total factor productivity' (TFP). Verspagen and Wakelin (Chapter 4) use both R&D and patents (another output measure). In spite of these differences in data and methods a common (and central) result is that technological innovation, whether measured by R&D, patents or TFP, significantly increases competitiveness and influences specialization patterns. Furthermore, both Fagerberg, and Verspagen and Wakelin find that although the estimated impact of R&D is larger in typical 'high-

tech' industries, innovation matters in many 'low-tech' industries as well. Thus, according to these studies, technological competition is not an exclusively high-tech affair.

The findings do not preclude that national resource endowments may have an impact on industrial localization. While some factors of production may have become increasingly internationally mobile, others, such as natural resources and human capital, still have a low degree of international mobility. Gustavsson, Hansson and Lundberg report that current specialization patterns are influenced by cross-country differences in the supply of various natural resources whereas human capital accumulation together with productivity growth determines changes in specialization.

In a 'Ricardian' model analysed by Drud Hansen (Chapter 6), in which technical progress is a function of learning, history matters for competitiveness, and original comparative advantages of countries tend to be reinforced over time. This is consistent with the fact that the specialization patterns of developed countries tend to be rather stable over time (see Wolff). Drud Hansen demonstrates that when allowing for differences in (a) technological capability, or productivity, across countries and (b) technological dynamism across sectors, trade may increase the lead of the country that initially has the upper hand in the dynamic sectors. Hence, lagging countries may have some reason for concern, if trade leads to specialization in stagnant sectors.

Theories that focus on economies of scale as a source of competitive advantage generally predict that with trading costs, large countries will have an advantage in industries where economies of scale are important. Melchior (Chapter 5) shows that in such a model the competitive advantage of a large home market will increase with the degree of product differentiation. This provides a theoretical underpinning to the 'standard goods hypothesis' suggested by Dreze (1961), that is, that small countries will specialize in homogeneous goods for which international demand is relatively standardized. Melchior's empirical results give some support for this hypothesis.

Recently, the interest in technology as a source of trade and growth has been stimulated by the advent of the so-called 'new growth theory', combining the assumptions of economies of scale and imperfect competition with an explicit role for the firm in generating new technology (Romer, 1990; Grossman and Helpman, 1991). The traditional theory in this area only allowed for small and temporary effects on growth of increased trade. As pointed out by Dowrick (Chapter 7) in his survey, the new growth theories challenge this view. Following these theories, increased openness may have permanent effects on growth. Of particular interest for this book is the case when trade may act as a direct transmission mechanism for the international dissemination of knowledge.

The process of diffusion of new knowledge, as well as the notion of technological spillovers and their geographical reach, are important for recent

theorizing on the impact of technology on growth and trade. If new technology is a global public good, it cannot induce trade; the argument is analogous to the case of perfectly mobile factors of production. However, little is known about the geographical reach of spillovers. Two of the chapters in this book throw some light on this issue. Fagerberg shows that new knowledge acquired indirectly through purchases of inputs – capital goods and intermediates – has a much higher impact on competitiveness and exports when inputs come from domestic sources than when they are imported. Sjöholm (Chapter 8) examines the impact of geographical proximity and contacts through trade on the dissemination of knowledge, using patent citations data as a measure of knowledge flows. He finds that both trade flows and proximity have a strong positive impact on knowledge flows.

New growth theory emphasizes the importance of business-sector R&D and its determinants for trade and growth. Countries that devote a large share of their resources to R&D will, other things being equal, gain the upper hand in 'high-tech' industry. However, if spillovers are national rather than global in nature, the social returns to investments in R&D will be higher in large countries. Hence, a large country may outperform a small one in 'high-tech' industry even if the latter initially spent more of its income on R&D (Grossman and Helpman, 1991). Fagerberg tests for the impact of R&D investment on export performance across countries of different sizes. Consistent with the theoretical predictions, the results suggest that the impact of R&D on exports is stronger in large countries.

The results reported here support the view that there is a strong geographical component to spillovers and knowledge flows in general. An important vehicle for overcoming such an obstacle is, of course, the multinational enterprise (MNE). If centres of technological excellence are widely dispersed, and proximity is important for being able to share in the progress that is generated, MNEs might find it useful to decentralize their R&D activities. Globerman (Chapter 9) considers the R&D strategies of multinational enterprises and the extent to which these have changed recently. He finds that some decentralization has occurred, though not for all MNEs and host countries. However, this seems to be mainly a response to increasing internationalization and the need to adapt products to foreign markets.

Sørensen (Chapter 10) and Honkatukia (Chapter 11) focus on the factors affecting innovation in open economies. Both chapters extend the models of the new growth literature by introducing a richer set of assumptions. Sørensen adds an educational sector and discusses the trade-off between devoting skilled labour to education or R&D in the private business sector. He points out that draining the educational sector for qualified personnel may have detrimental consequences for the long-run performance of the economy. Honkatukia

introduces a monetary sector. He finds that in such a model an expansionary monetary policy may slow down the rate of innovation.

One of the reasons for the public interest in the technology-competitiveness issue is the possible link with employment. Verspagen and Wakelin consider this link in some detail for the mutual trade between three large European countries in the 1980s. They find that although the partial effect of differences in technological activity, capital accumulation and costs on employment might be quite important, they tend to cancel out, so that the total effect of trade on employment is negligible. However, if trade induces structural changes in the economy that change the demand for workers with different kinds of skills, a skill mismatch may occur. This may lead to reduced compensation for certain skill groups as well as unemployment. Hansson (Chapter 12) finds that the increase of the average skill level of the Swedish industrial labour force reflects increased use of skilled labour within firms, rather than a structural shift towards high-skill sectors. Although increased internationalization (trade exposure) may have had a say in this, Hansson points out that skill-biased technical change seems to have been the most important factor.

Competitiveness in the global market place is continuously shifting. New producers will emerge on the world market, in particular from Asia and the formerly planned economies in Europe. A basic conclusion from the work reported in this book is that technology plays a central role for competitiveness, and that its importance may very well be increasing, since many other factors, such as physical capital, will probably become increasingly mobile. To some extent, technology may have become more internationally mobile, for example, through the operations of multinational firms. Nevertheless, the results in this book indicate that domestic innovative activity is still a major determinant of competitiveness, and that geographical proximity seems to be important for knowledge flows. In comparison to technology, most other factors often linked to competitiveness seem to be of secondary importance.

The results presented in this book may give some guidance for policy. First, the results suggest that a sufficiently high level of domestic R&D is a necessary condition for international competitiveness. This holds for both large and small countries, although some of the results indicate that very large countries may get more out of their R&D than other countries. It also holds for a whole range of industries, not only the very 'high-tech' industries that increasingly have come to be dominated by the USA and Japan. Second, specialization in technologically stagnant sectors may present a problem for future economic growth. Third, the competitive advantages of large and small countries differ. Hence, it would be a mistake for the small countries to use the specialization pattern of the large ones as a kind of yardstick of success.

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Tables

1. Productivity growth and shifting comparative advantage on the industry level

Edward N. Wolff*

Dollar and Wolff (1993) analysed changes in both productivity levels, resource abundance, and export patterns for a sample of nine OECD countries covering the period from 1970 to 1986. We found strong evidence of convergence on the economy-wide level in GDP per worker, the capital–labour ratio, aggregate total factor productivity (TFP), and average real wages. We also examined the same variables for nine manufacturing sectors and found that, except for real wages, convergence at the industry level was generally not as strong as that for the economy as a whole. In fact, aggregate convergence in labour productivity, for example, was to some extent attributable to the modest labour-productivity leads that different countries enjoyed in different industries. The results are similar for TFP and capital intensity.

A further result of this development is that the export patterns of the industrial countries were not converging or becoming more similar. This result is consistent with our conclusion that specialization has continued at the industry level in the advanced industrial countries. Moreover, at least in the case of Japan and the USA, a clear relationship is evident between TFP growth at the industry level and changing comparative advantage. The industries in Japan with growing comparative advantage over this period tended to be those in which its TFP relative to the USA increased especially rapidly. We argued that TFP captures some influence that contributes to comparative advantage, and this factor is likely to be technology as disembodied knowledge, as embodied in machinery, or as reflected in skilled labour.

The present chapter will extend the time period to 1992 and the country coverage to 14 OECD countries. Moreover, it will employ regression analysis to examine the relationship between comparative advantage and relative technology levels to the full set of countries, rather than to bilateral comparisons as we did in our previous work. It will make use of the 1994 version of the OECD International Sectoral Database (ISDB). The focus will be on both revealed comparative advantage in terms of export shares and on total production shares