ELSEVIER Information Economics and Policy 14 (2002) 253–273

INFORMATION ECONOMICS AND POLICY

www.elsevier.com/locate/econbase

The software industry and India's economic development

Ashish Arora[a], Suma Athreye[b,*]

[a]Heinz School of Public Policy and Management, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA 15213, USA

[b]Faculty of Social Sciences, The Open University, Walton Hall, Milton Keynes MK7 6AA, UK

Abstract

This paper assesses the contribution of software to India's economic development, paying particular attention to the role of software in the absorption of labour and the development of human capital in the economy. The success of the software industry has increased the relative value of professional workers, not only programmers, but also managers and analysts. The growing importance of human capital, in turn, has led to innovative models of entrepreneurship and organization, pioneered by the software sector, and these are slowly taking root and spreading to other sectors of India's industry. A potentially important and under-appreciated contribution of the software industry is thus its exemplar of good entrepreneurship and corporate governance to the rest of India. Though less visible than the macro contributions to employment and foreign exchange, this role is a source of productivity improvement for all industries, and can have powerful long-term benefits for India's industrialization and growth.

Keywords: Indian software; Software exports; Software and growth; Human capital and development

JEL Classification: F1; I2; L8; J5; O0

1. Introduction

In little over a decade, India has emerged as a major exporter of software in the international economy. This remarkable feat has been accomplished through the extraordinary growth of Indian software which, in the last 5 years, expanded at a compound annual rate of 56%. More than two-thirds of this was due to exports,

*Corresponding author. Tel.: +44-1908-65-45-56; fax: +44-1908-65-44-88.

E-mail addresses: ashish@andrew.cmu.edu (A. Arora), s.s.athreye@open.ac.uk (S. Athreye).

0167-6245/02/$ – see front matter
PII: S0167-6245(01)00069-5

making the industry a major export earner for the country. The proportion of software exports to merchandise exports grew from a negligible amount in 1990 to over 6% in 1998–1999. Remarkably, these software exports are largely due to the efforts of domestic rather than foreign firms. Of the top 20 exporters in 1998–1999, only six firms were foreign subsidiaries.

The software industry contributes 1% of India's GNP, but has accounted for over 7% of the growth of its GNP (Kumar, 2000a,b). In 1997, the software industry employed 160,000 of the total employed workforce of 28.245 million. Employment in the industry, although constituting only a small fraction of the total, has grown quickly and estimates for the year 2000 suggest that there will be over 410,000 IT professionals employed in India.

Can the software sector continue to contribute significantly to economic growth, and what forms are these contributions likely to take? To answer this question, we begin by examining in Section 2 the factors that have contributed to India's emerging specialization in software exports. We argue that software services are intensive in human capital and the abundant supply of engineers in the country provides not only an absolute wage advantage, but also a comparative advantage. In Section 3 we review the factors that constrain the current growth of the software industry on the supply side, in particular the role of underinvestment in literacy and in telecommunications infrastructure. Section 4 analyses the contribution of software growth to human capital formation. High earnings in software have resulted in considerable private investment in training, and the subsequent emergence of a successful self-financing model of tertiary education in some parts of the country. Section 5 analyses the impact of software on productivity improvements through the linkage effects of software in the domestic economy. We conclude that this mechanism of productivity improvement is of limited importance in the Indian context. Section 5 emphasizes the role of high software salaries versus the rest of India's industry in creating productivity-inducing organizational improvements in software. We also analyse the role of software firms as organizational exemplars. Section 6 summarizes our main conclusions.

2. Factors favouring the growth of software revenues in India: the role of comparative and absolute advantages

Software is not just another industry. The number of companies that produce software or employ software developers is much greater than the set of firms commonly thought of as software firms, such as Microsoft or Oracle. Indeed, large banks, insurance companies, finance companies, and virtually every organization above a certain size all develop a great deal of software. Much of this software is either developed for a particular user, or consists of a standard 'platform' such as a SAP ERP system or an Oracle accounting system, and is customized to the needs of the user organization. Once in place, these systems have to be maintained and