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Identifying technological capabilities with different degrees of coherence: The challenge to achieve high technological sophistication in latecomer software companies (based on the Bulgarian case)

Rossitza Rousseva *

United Nations University Maastricht Research and training centre on Innovation and Technology (UNU-MERIT), Maastricht, The Netherlands and Science and Technology Policy Research (SPRU), University of Sussex, Brighton, UK

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Abstract

The paper introduces the notion of coherence of technological capabilities. It argues that in analysing technological capabilities (TC) the analysis needs to go beyond investigation of constituent capabilities and should take into account the level of coherence among the constituent capabilities. The phenomenon of different degree of coherence of TC is detected while exploring the TC in Bulgarian software companies. Significant differences emerge between the TC of domestic-oriented vs. export-driven companies in the accumulation of constituent capabilities. But it is the analysis of the coherence of TC, which proved capable to capture the real differences in capability accumulation: strong coherence occurs only in 'export' TC. This analysis revives the debate about possibilities for leapfrogging by latecomers by developing software industries. Based on the results the study revises the 'walking on two legs' hypothesis and also points that the optimistic forecasts about the possibilities for leapfrogging by the latecomer countries by developing indigenous software industries might have been overestimated.
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Keywords: Technological capabilities; Software industry; Leapfrogging

* Current address: United Nations University Maastricht Research and training centre on Innovation and Technology, UNU-MERIT, Keizer Karelplein 19, 6211 TC Maastricht, The Netherlands. Tel.: +31 43 3884451; fax: +31 43 3884499.
E-mail addresses: rousseva@merit.unu.edu, R.I.Rousseva@sussex.ac.uk.

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1. Introduction

In the last two decades a group of studies has been emphasising that the information technologies (ITs) present a 'window of opportunities' for latecomer countries to catch-up by developing indigenous software industries [1]. It has been outlined that the availability of skilful human capital creates a solid base for development of an IT industry by the latecomers. The software industry is, in principle, low-capital but knowledge and skill-intensive industry, and the international market for software is big and growing [2]. For this reason, the discussion about developing indigenous software industries in the latecomer context has gained particular attention both in academic and policy literature for more than a decade [3].

The last decade saw a sharp increase in software development activities undertaken by latecomer companies. India is a prominent example in this direction followed by Brazil and China. A number of other latecomers also have directed efforts towards developing software industries.

However, developing an indigenous software industry in a latecomer or less-advanced context is not a straightforward task. Software production is almost by definition an innovation activity because it aims to produce new products or new ways of executing known tasks and functions [4]. Therefore, to undertake software activities companies need to possess innovation capabilities. Development of innovation capabilities however is a daunting task for the latecomers, as studies in technological capability building have repeatedly revealed [5]. Very few latecomer companies have managed to enter the international markets and this holds not only for the software industry but for all high and medium tech industries. This fact amplifies the need to scrutinise the accumulation of technological capabilities and development of innovation capabilities, and to compare between successful and less successful companies.[1]

Studies about technological development in latecomer context have been predominantly focusing on companies that have been successful in building technological capabilities but relatively little research has been done to compare these with companies that are half-way through the process. This paper takes a journey into that direction. Investigating the complexity in technological capabilities building, the paper analyses the differences in accumulation of technological capabilities between companies that have managed successfully to build technological capabilities (export-driven companies) and those that are still under way (domestic-oriented companies). The main proposition advanced is that if they are to make a comprehensive account of the technological capability the studies need to explore not only the accumulation of constituent capabilities[2] but also (and more importantly) the level of coherence among the constituent capabilities. The paper introduces the notion of coherence of technological capabilities and applies it empirically. The study investigates the development of technological capabilities in one latecomer software industry, taking the case of Bulgaria, a country which has been developing an indigenous software industry for over two decades.

The paper is structured as follows. The following two sections lay the theoretical background of the research: Section 2 makes an overview of the concept of technological capabilities building and Section 3 introduces the notion of coherence of technological capabilities. Section 4 presents the methodology of

[1] These kinds of analyses have to investigate both the technological capabilities and the learning efforts contributing to the accumulation of the technological capabilities. This paper focuses only on the technological capabilities and leaves the learning efforts for further research.

[2] By constituent capabilities we refer to the range of capabilities constituting technological capability. This range may differ across sectors, as it bears a sector-specific element but in general it encompasses capabilities for engineering, design, etc. In the text we will use 'constituent' and 'individual' capabilities interchangeably.

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