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Information technology and its changing roles to economic growth and productivity in Australia

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ABSTRACT

In this paper we describe our investigation of the role of investment in information technology (IT) on economic output and productivity in Australia over a period of about four decades. The framework used in this paper is the aggregate production function, where IT capital is considered as a separate input of production along with non-IT capital and labour. The empirical results from the study indicate the evidence of robust technical progress in the Australian economy in the 1990s. IT capital had a significant impact on output, labour productivity and technical progress in the 1990s. In recent years, however, the contribution of IT capital on output and labour productivity has slowed down. Regaining the IT capital productivity therefore remains as a key challenge for Australia, especially in the context of greater IT investment in the future.

1. Introduction

Since the late 1990s a significant number of studies have examined the contribution of information technology (IT) on productivity and economic growth, predominantly using data for the United States (US) (Jorgenson & Stiroh, 1999, 2000; Oliner & Sichel, 2000) and concurrently for other countries (e.g., Parham, Roberts, & Sun, 2001, for Australia). These studies have shown a strong contribution of IT capital on productivity and growth in the 1990s. In the 2000s, however, productivity growth has slowed down in most advanced countries (Dolman, 2009). Questions therefore arise on the appropriate role of IT investment on economic growth and productivity in the historical context. Moreover, there is a need to reappraise the role of IT capital in the present context to design intervention strategies for the future.

The present work aims at quantifying the contribution of IT capital to economic output, productivity and technical progress using Australian data for 1975–2011. The growth and productivity improvements in Australia during the late 1980s and 1990s have long sparked interest to researchers. Australia sustained a remarkable growth performance during the period of financial crisis in the 1990s – quoting the country as a 'miraculous' economy (Krugman, 1998). Productivity improvement is seen to be a major source of the robust economic performance and the IT revolution has been identified as the major contributor to the productivity performance during the period (Banks, 2001; Parham, 2005a; Parham et al., 2001). Cross-country studies identified a very strong contribution of IT capital on economic growth in Australia during the 1990s – just behind the much-noted US and the largest among the OECD countries (Colecchia & Schreyer, 2002). However, sceptics view the productivity surge in Australia in the 1990s as just a statistical illusion (Dolman, 2009; Quiggin, 2006).

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Nevertheless, Australia's productivity performance has fallen short of expectations since the 2000s where the growth rates of multifactor productivity slipped down, on average, from 1.7% during the 1990s to 0.4% during the 2000s and to −1.3% in 2011 (ABS, 2012a). Therefore, the role of IT capital on economic growth and productivity remains a conundrum, especially for those who advocate that IT capital accumulation placed a profound impact on the productivity surge of the 1990s and also in the context of promoting greater IT investment in the forthcoming years. Hence, to enlighten this debate, there is a need to reassess the contribution of IT on productivity and economic growth in Australia with the use of historical and newly available data.

Significantly, there is little empirical research to shed light on the role of IT investment on productivity and growth, especially using the most recent data. Moreover, existing studies on causality analysis in this area are mostly relied on bivariate models, which impose limits on an accurate analysis due to the omitted variable problem. To overcome the issues, this paper implements a multivariate approach and employs the Toda and Yamamoto (1995), hereafter TY test, to explore long-run causality among the variables. The TY approach has several advantages over conventional tests for Granger causality. The approach obviates the need to pre-test for cointegration and is often preferred over the error-correction based tests – the latter tends to have a larger size distortion (Zapata & Rambaldi, 1997; Zhang & Cheng, 2009). In addition, given the viewpoint that IT investments have important spillover effects and may generate externalities (Levendis & Lee, 2012; Röller & Waverman, 2001), the possibility of an endogeneity between the variables of interest can be captured by implementing simultaneous equation modelling within the TY framework to explore the direction and sign of causality (Bowden & Payne, 2009; Shahiduzzaman & Alam, 2012; Squalli, 2007). Finally, with few aggregate models applied to capture the effects of IT investment on output and productivity developments in Australia, this study covers data from the mid-1970s to 2011, providing an overall understanding both on the recent and historical contexts.

The paper is organised as follows. Following this introduction, Section 2 provides a historical overview of economic performance and IT use in Australia. Section 3 gives a brief review of the theory and evidence. Section 4 illuminates the methodology and data and Section 5 presents the empirical results. Finally, Section 6 provides a conclusion and some policy implications.

2. Economic performance and IT use in Australia

Productivity performance in Australia was remarkable in the last few decades with a major resurgence in the 1990s (Parham, 1999). Indeed, apart from a short-lived business cycle downturn in the early 1980s, both labour and multifactor productivity have grown, on average, at a positive rate and the improvement was sustained during the period associated with the recession in the early 1990s (Fig. 1). The robust productivity performance of the Australian economy has led the gross domestic product (GDP) growth to hover around 3% on average in the long-term context (Fig. 1), which is a remarkable as compared to comparable advanced countries. It is viewed that higher productivity growth generally leads to periods of sustained economic growth and, consequently, improved standards of living. Understanding the underlying factors is of profound importance in the context of long-term prosperity and is, therefore, a major concern for policy makers.

Existing studies provide different factors for the acceleration of Australia's productivity growth in the 1990s (Productivity Commission, 1999). In general, they fall into two broad categories – one is the microeconomic reforms started in the mid-1980s and the other is the uptake of the latest IT in the 1990s (Parham et al., 2001). It is suggested that microeconomic policy reforms played a pivotal role in shaping a favourable environment for the Australian business sector to adopt new technologies and to put them to play a productive roles in the 1990s (Banks, 2001; Parham, 2002a; Parham et al., 2001). Fig. 2 shows the exponential growth of IT capital share to total capital from the mid-1980s – its timing and magnitude might have placed a significant impact on economic and productivity performances in the 1990s (Parham et al., 2001).

The deterioration of productivity and consequent economic performance in the 2000s, however, created a major concern. IT investment as represented by 'Information Technology Gross Fixed Capital Formation' in chain volume measures grew at

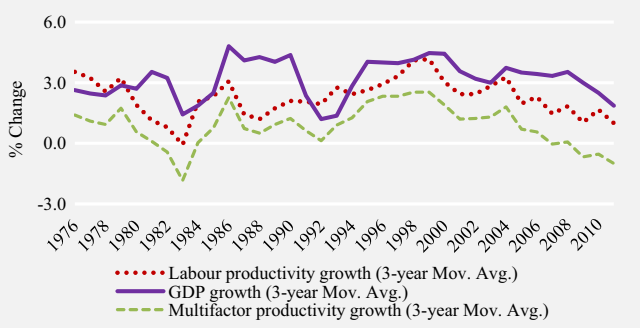

Fig. 1. GDP and productivity growth (3 year moving average), 1976–2011.
Source: GDP growth data – cat no. 5206, Table 30, Australian Bureau of Statistics for growth rates of gross domestic product: Chain Volume (Reference year 2009–2010) – % Change. Productivity data – cat. no. 5260.0.55.002 experimental estimates of industry multifactor productivity, Australia: detailed productivity estimate, Table 4, indexes (2009–10 = 100). Data extracted online from http://www.abs.gov.au/AUSSTATS/ on 11 September, 2012.