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# The dynamics of information and communications technologies infrastructure, economic growth, and financial development: Evidence from Asian countries



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## ABSTRACT

This paper investigates causal relationships between information and communications technologies (ICT) infrastructure, financial development, and economic growth in Asian countries over the twelve-year period 2001–2012. Using panel cointegration techniques, our empirical results show these variables are cointegrated, with a myriad of short-run and long-run causal links between ICT infrastructure and economic growth, between financial development and economic growth, and between ICT infrastructure and financial development.

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## 1. Introduction

Information and communications technologies (ICT) are increasingly associated with more rapid economic growth, especially during the pronounced globalization era of the 1990s [28,45]. Today, ICT are vital components of modern infrastructure, with widespread applications through world economies. They initiate and reflect new technological developments, and foster widespread cost-reducing innovations, affecting innovative behaviour, economic restructuring and productivity performance in all sectors of the modern economy (see, for instance, [15,19,36,49,74,75,95,96,106,111,118,127,128,129]). The significance of ICT lies in the fact that the technologies are

general purpose [14]. The main features of these technologies are their fast path of technological improvement, their pervasiveness across the full spectrum of the economy, and their role as innovation-enablers. ICT allow closer links between firms, their customers, suppliers, and collaborative partners. They also lower geographical barriers. In addition, they help the creation of new knowledge and its faster diffusion through more efficient process of information transformation, both within and between firms and sectors [47,72,74].

Many contemporary theories of economic growth acknowledge the significance of ICT. The most prominent are Neo-Schumpeterian theories, building on Kondratiev's perception of long waves of economic 'boom' and 'bust' and Schumpeter's work from 1910 on the role of innovative entrepreneurs exploiting market imperfections to lay the foundations for future growth [105,112]. These theories relate to specific types of technologies to specific epochs of economic development. The ICT are characterised as

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'pervasive' only if their applications affect almost all sectors of the economy [8].

The empirical literature provides significant support for a positive relationship between ICT infrastructure and economic growth (see for instance, [16,17,31,38,63,70,71,76,77,80,87,90,108,117]). However, these studies investigate solely the relationship between ICT infrastructure and economic growth without looking at the directions of causality. A main objective of this paper is to overcome this deficiency to examine more broadly the causes and consequences of the availability of ICT infrastructure. In particular, the paper investigates the short-run and long-run relationship between ICT infrastructure and economic growth for Asian countries, using a panel data approach. We also introduce a third variable, namely financial development, in the analysis.

Financial development is defined in terms of the aggregate size of the financial sector, its sectoral composition, and the range of attributes of individual sectors that determine their effectiveness in meeting users' requirements. The evaluation of financial development should cover the roles of the key institutional players, including the central bank, commercial and merchant banks, saving institutions, development financial institutions, insurance companies, mortgage entities, pension funds, the stock market, and other financial market institutions [55,126]. Evidently, financial development includes both banking sector development and stock market development. Thus, two additional key hypotheses of this paper are that financial development is linked to both ICT infrastructure and economic growth.

Our working hypothesis is that ICT infrastructure has contributed significantly to both financial development and economic growth. Our alternative hypothesis for testing is that the expansion of ICT infrastructure is simply a consequence of financial development and economic growth. We also examine the possible direct causal link between financial development and economic growth as a corollary.

This paper is organized as follows. A review of the literature is given in Section 2. The following section outlines the contributions of the study. Data and the empirical model are explained in Section 4. The econometric analysis and empirical results are discussed in Section 5. The final section offers conclusions flowing from our analysis.

## 2. A brief overview of literature

### 2.1. ICT infrastructure and economic growth

The first strand of literature considers the possible link between ICT infrastructure and economic growth. Theoretically, there is a direct association between ICT infrastructure and economic growth (see Fig. 1), treating ICT as an exogenous force emerging from innovation and government or corporate decisions, manifesting in multiplier effects on real economic activity.<sup>1</sup> Significant research

supports this association [31,40,56,101,113]. All these studies (e.g., [21,48,110,124,130]) found a positive correlation between ICT infrastructure and economic growth. However, the causality between ICT infrastructure and economic growth has spawned considerable interest among economists since the seminal work of [35]; which supported a bidirectional causal relationship in the US. Subsequently, there have been many similar studies for both developed and developing countries. While most of these studies have confirmed the existence of a causal relationship running from ICT infrastructure to economic growth [21,27,40,101,102,131], there are a few cases where there is no evidence of causality from ICT infrastructure to economic growth [40,116,119]. Hence, the empirical studies on the relationship between ICT infrastructure and economic growth do not provide any definite conclusion and currently there is no consensus among economists about the nature of this relationship. In summary, there are four possible relationships have been emphasized in the empirical literature on the causal link between ICT infrastructure and economic growth: unidirectional ICT-led growth hypothesis, unidirectional growth-led ICT hypothesis, the feedback hypotheses, and the neutrality hypothesis.

In this context [2,21,29,40,85,108,115,124], find results in support of an ICT-led growth hypothesis (i.e., a supply-leading hypothesis – SLH). By contrast, [10,102,119,132] support the validity of growth-led ICT hypothesis (i.e., a demand-following hypothesis – DFH). Moreover [22,23,33,34,73,103,107,116,124,125], find existence of a mutual causal relationship between the two variables (i.e., they support a feedback hypothesis – FBH). Finally, some studies find a complete lack of a causal relationship between the variables - or a null hypothesis (NLH). The absence of causality is supported by very few papers [40,116,119]. Table 1 presents a summary of these previous studies.

### 2.2. Financial development and economic growth

The second strand of the literature considers the possible link between financial development and economic growth. In this context [26,37,42,44,50,58,69], establish the validity of financial development-led growth hypothesis (i.e., a DFH). At the same time [1,12,20,53,64,79,92,103], prove the validity of growth-led financial development hypothesis (i.e. a SLH). On the other hand [5,9,11,18,66,68,82,91,93,100,121], demonstrate the validity of a feedback hypothesis (that is, bidirectional causality). A summary of these previous studies is shown in Table 2.

## 3. Relevance and contribution of the study

Since the end of the 1980s, most Asian countries have sought by official policy determinations to foster financial development, for example, by reducing governmental intervention in national financial sectors or by privatizing banks. Such policies have been designed to promote economic growth through, inter alia, a higher mobilization of savings or a rise in domestic and foreign investment [133].

<sup>1</sup> For a recent study adopting a narrower definition of ICT, focussing on the link between broadband internet and economic growth, see Ref. [7].

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