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Extended Abstract

Simultaneity between Mobile Penetration and Economic Growth: A Panel data analysis of Indian States

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Abstract

The growth in mobile telephony has added further momentum to the process of financial inclusion, rural development, and economic growth in general. However, despite the substantial growth, there exists a disparity in mobile penetration across states. The relationship between mobile telephony diffusion and economic growth has been well documented. While earlier studies have analyzed the relationship between economic growth, mobile technology diffusion, and inequality in different contexts and times, these relationships have been analyzed in isolation. The current study has used data on the Indian States for 2002-2012. It employs the Three-Stage Least Squares (3-SLS) technique to estimate a simultaneous system of equations to analyze bi-directional causality between economic growth and mobile penetration and feedback of one variable into another. The study also extends the analysis to 2016 using an alternative measure of inequality. The results confirm the positive feedback of growth to mobile penetration and find a positive impact of urban inequality on mobile penetration.

KEYWORDS*:* Telecommunication, Inequality, Economic growth, Panel Data, 3SLS

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Extended Abstract

1. Introduction

Mobile telephony has shown exponential growth in the recent decade. Research has established the positive impact of mobile phone diffusion on economic growth and financial diffusion (Ghosh 2016). Mobile technology reduces friction present in economic development by broadening access to information (Jensen 2007), improving access to capital, and expanding market access by overcoming geographic limitations. Mobile telephony has become multi-functional with the many diverse purposes it serves. From a simple device for a phone call and messaging, mobile telephony has evolved into a device for instant messaging, gaming, GPS navigation, internet browsing, banking, ordering food, shopping. Thus, in the present scenario, it has transformed space into the digital world, which has made life and businesses much easier.

While existing studies provide rich insights into the growth-technology relationship, these studies have been done mostly at the cross-country level. Moreover, studies at the country level have analyzed the relationship between mobile technology diffusion and growth with a minimal focus on the role of inequality in the diffusion process. Further, the role of rural and urban inequality has not been examined in detail on mobile diffusion. This study attempts to fill these gaps using panel data on Indian states from 2002-2012.

2. Literature Review

Lee and Cho (2007), in a study regarding Korea for the period 1984-2002, found a significant positive impact of per capita GDP on the diffusion rate. Studies that model penetration rates found evidence of the positive impact of mobile penetration on economic growth (Ghosh 2016; Kathuria et al. 2009). Other studies also supported a positive and significant impact of economic growth indicated by per capita GDP on the penetration rate of mobile telephony (Frank 2004).

Mobile technology is increasingly considered a factor in economic growth rather than a consequence of it (Tcheng et al. 2007). Three characteristics of mobile technology that can explain this are the omnipresence of mobile technology in most business sectors, continuous improvement in mobile technology reducing the cost to users, and its contribution to innovation and development of new products and processes(Andrainaivo and Kpodar 2011).

Andrainaivo and Kpodar (2011) confirmed that mobile phones contribute significantly to economic growth, and a part of this positive effect comes from greater financial inclusion. Ghosh (2016) also suggested that financial inclusion is one channel through which mobile penetration supports growth. Olla and Choudrie (2013), using the EFR (Ethnographic Futures Research) approach, concluded that there is an opportunity to deploy different paradigms of mobile services creation for social development. Mushtaq and Bruneau (2019), using data on 62 countries for the period, found that penetration of mobile telephony, when used as a measure of ICT, decreased inequality and poverty.

In an early cross-country study for 1960-1973, Hardy (1980) analyzed the correlation between GDP and telephone density and found evidence supporting bi-directional causality and mobile penetration was both a cause and consequence of GDP growth. Roller and Waverman (2001) established a strong causal relation between mobile telecommunication infrastructure and productivity using a simultaneous equation model of telecom investment and macro production function for 21 OECD countries for 1975-1990. The study addressed two-way causality between mobile-telecommunication infrastructure and productivity using a structural equation model with a hybrid production function that endogenized telecom investment. They specified a micro model of supply and demand of telecom and jointly estimated them with a macro growth equation.

Thus, there is evidence of bi-directional causality and interdependency between economic growth and mobile penetration. The above studies suggest that mobile technology diffusion is determined by economic growth. Also, economic growth, in turn, has a role in the penetration of mobile technology. Thus, we see clear evidence of feedback from mobile penetration and economic growth into one another, which, in turn, are determined by other key independent variables.

Factors influencing economic growth and diffusion of mobile technology:

The relationship between inequality and growth follows a typical inverted U-shape curve represented by the famous Kuznets curve. However, the finding with respect to mobile penetration and inequality is mixed. In an important cross-country study on mobile technology diffusion for developing countries over the period 1985-1998, Hyytinen and Toivanen (2011) found that within-country income inequality was positively related to early diffusion, as mobile telephony was being used as luxury consumption good for the rich and elite section of the society and as important production good by poorer section of the society. In a cross-country study, Mushtaq and Bruneau (2019) found that Information and Communication Technology (ICT), including mobile phones, reduced poverty and inequality.

Given the evidence of the role of mobile phones in reducing inequality and poverty, bridging the digital divide prevalent in the economy at many levels becomes even more important. The role of inequality

becomes important to analyze the diffusion of mobile telephony as it is a consumption good used as a means of communication and a production good that facilitates many businesses or processes of businesses.

Other factors that affect the diffusion of mobile technology derived from the existing literature review include industry observables, fixed-line penetration rate, Herfindahl-Hirschman Index (HHI) of market concentration, and demographic observables comprising the dependency ratio and the literacy rate. Fixed lines penetration rate affects the diffusion of mobile penetration, and previous studies find mixed evidence in this regard. As measured by Herfindahl-Hirschman Index (HHI), market competition is a significant factor affecting penetration rate as greater competition makes the technology accessible and affordable to the masses. HHI is calculated as the squared sum of market shares and is bounded between 0 and 1, with 0 being the most competitive and one indicating monopoly. The way HHI is constructed, the lower the value of HHI, the highly competitive the market is. Therefore, HHI is considered to have a negative impact on the penetration rate. The negative impact of HHI indicates that the higher the concentration, the lower is the mobile penetration, or in other words, higher competition in the market leads to higher mobile penetration.

3. Data and Methodology

The study uses a sample comprising data for the period 2002-2012 for 18 major Indian states. It combines several data sets at the state level from different secondary sources, including mobile-related data, data to financial access, inequality data, macroeconomic data, and other state-specific variables.

The model of mobile penetration and economic growth is estimated simultaneously using the 3-SLS estimation technique to take into account the bi-directional relationship between variables. Literature analyzes these variables or part of them in the same equation, but empirical evidence points to important indirect interactions and thus endogeneity issues. Imbs (2004, 2006) estimate a simultaneous system of the equation to disentangle direct impact from indirect channels and eliminate endogeneity problems.

4. Results

Initial results indicate that Urban inequality has a positive and significant impact on the penetration of mobile phones, i.e., as urban inequality increases penetration rate. However, inequality in rural areas is not significant in explaining the diffusion rate of mobile telephony. Other control variables like NSDP per capita have a positive and significant impact on the penetration of mobile phones. The coefficient on fixed-mobile is negative and significant, and thus mobile phones are a substitute for fixed-line telephones. Thus, a decrease in fixed-line penetration leads to an increase in mobile penetration. HHI is significant in explaining the penetration of mobile phones for the period of analysis and has a negative effect on the

penetration of mobile telephony as expected, i.e., greater competition leads to higher adoption of mobile phones. We also find evidence of the positive and significant impact of mobile penetration on the NSDP per capita, i.e., mobile phones have supported economic growth.

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