

STUDIES ON TECHNO-MANAGERIAL ASPECTS IN THE DEPLOYMENT OF NEXT GENERATION MOBILE BROADBAND SERVICES

Abstract

The rising global demand for mobile broadband services is leading to rapid deployment of 4G-LTE (fourth-generation – Long Term Evolution) networks by Mobile Network Operators (MNOs) the world over. Provisioning of 4G-LTE services though necessitates significant capital investment on the part of MNOs toward both network infrastructure deployment and radio spectrum acquisition. Yet, the technical and financial feasibilities associated with 4G-LTE service provisioning depend on a host of factors, such as the future market potential of 4G-LTE, data rate supported, choice of the carrier frequency (CF), spectrum availability, and prevalent regulatory imperatives (in the form of service licensing regimes). Such challenges are more prominent in India, where MNOs are forced to invest in the deployment of 4G-LTE network infrastructure despite plummeting revenue figures, in a bid to capture new subscribers as well as sustain their existing subscriber base. Additionally, the geographic segregation of India into twenty-two administrative zones (referred to as telecom circles) with an uneven potential for profitability, further add to the complexities in the network deployment decisions of MNOs. The present thesis attempts to investigate some of these concerns pertaining to the MNOs of India with the help of three main research questions (RQs).

In the first RQ, we employ a diffusion-theoretic approach to empirically analyze the countrywide growth of 4G-LTE mobile subscription in India. To

do so, we make use of “technology diffusion models,” which quantify various characteristics of diffusion of an innovation. Notably, we conduct analyses for both single-generation diffusion and multi-generation diffusion of 4G-LTE services. The single-generation analysis does not take into account the sales impact due to prior generations, namely 2G and 3G, whereas the multi-generation diffusion takes into account the intergenerational dynamics amongst 2G, 3G and 4G-LTE services for a given market. Once we have decided on the suitable model to be used for 4G-LTE diffusion in India, we use the time-series data of countrywide subscription of 2G, 3G, and 4G-LTE services in India for the above-mentioned diffusion analyses. Methodologically speaking, our analyses employ a combination of linear and non-linear techniques of regression, namely ordinary least-squares (OLS) and non-linear least-squares (NLS) regression. We undertake extensive forecasting exercise to estimate the future market potential of the twenty-two telecom circles individually. We find that the informal channels of communications, such as word-of-mouth, have a much greater impact on the diffusion of 3G and 4G-LTE services in India. Such impacts are, in fact, more significant for 4G-LTE services compared to 3G services. We also find that the multi-generation model is more accurate at forecasting the future market uptake of mobile broadband services in India.

In the second RQ, we build on the output of RQ1 to propose an overarching Techno-economic model (TEM) for assessing the overall requirements concerning coverage and capacity for various 4G-LTE deployment scenarios, cost, revenue, and profitability measures important for managerial decision making. Here, we combine multiple modeling approaches

borrowed from relevant theoretical paradigms. To be specific, we draw upon radio propagation models from the wireless communications literature, and the discounted cash flow (DCF) valuation model from the strategy of financial investment literature. Taking the case of a fictitious Indian MNO, we estimate the levels of the 4G-LTE network infrastructure required for meeting the capacity across these telecom circles. We also determine the levels of the 4G-LTE network infrastructure for meeting the coverage requirements across these telecom circles by using the various “carrier frequencies” marked for 4G-LTE service provisioning in India. After calibrating the network infrastructure requirements towards coverage and capacity, we estimate the total effective capital investments likely to be incurred by the fictional MNO towards the deployment of such 4G-LTE network infrastructure. We then predict the likely revenue from provisioning such 4G-LTE services in the near future and assess the associated profits and losses across these telecom circles. Our analyses indicate that the countrywide deployment of 4G-LTE networks, which adheres to the global quality of service standards, can also be financially viable for MNOs in India. We also find the need for rationalization of reserve prices of the spectrum, especially in the sub 1 Gigahertz (GHz) carrier frequencies, across the telecom circles in the country. We conclude that the policymakers in India need to take into account the potential of spectrum in terms of estimated financial returns, in addition to valuing the spectrum based on its technical characteristics and the benchmarks of prior auction prices.

In the third RQ, we formulate various econometric models for evaluating the impacts on the incumbent MNOs’ mobile subscriber base due to capital

investments in mobile network deployment, spectrum acquisition, and marketing and advertising initiatives. Additionally, we also investigate the impacts on MNOs' mobile subscriber base due to the introduction of 4G-LTE services in India. We use a novel longitudinal dataset (quarterly) of the four major private MNOs in India during the years 2009 to 2017. We have also controlled for other confounding factors, such as firm-size, competition, penetration of fixed-line services, and income. Based on our empirical findings, we have proposed a novel India-centric framework, which explains the "firm-level drivers" of mobile subscriber base for the incumbent MNOs in the country. We find that MNOs' capital investments (both current and prior investments) towards spectrum and mobile networks have a causal impact on its mobile subscriber base – albeit the impacts due to investments in the mobile network taking place after some time-lag. However, in the event of the launch of a new mobile service generation (aka network standard) in the market, the prior investments in the spectrum (in older carrier frequencies) cease to have a significant impact on the mobile subscriber base of MNOs. Thus, contemporary investments in spectrum become the critical factor, which can help in ramping up the mobile subscriber base of MNOs in this case. Early network preparedness, however, continues to play a significant role in determining the mobile subscriber base of MNOs in this case as well. We also find that, in the event of the introduction of a new mobile service generation, such as 5G, MNOs having better network preparedness and potential investment capability in the spectrum, in addition to having a larger size, are more likely to survive in the market.