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<center>学位論文の要旨</center>

After digital mobiles, third generation (3G) technology around the world have come across to a new platform of debate among regulators and policy makers. With an optimistic view, developed countries have taken the first initiative to allocate 3G spectrum for proper deployment and to meet the criteria of IMT-2000 as standardized by ITU. Although digital mobiles have ensured faster growth and reached toward saturation within a decade or less, but a different phenomena is observed for 3G technologies except Japan and Korea. Still, several important issues are unobserved and difficult to determine what factors have significant effect on 3G technology. There are, however, only few studies have attempted to empirically analyze factors promoting 3G technology both in Japan and in the world. This is because 3G is new technology among different countries and it is difficult to identify the effect of services and technological innovations on 3G deployment. In addition, micro and macro level data is limited to analyze empirically which factors have significant effect on 3G technology both in Japan and in the world.

The thesis aims to provide explanatory and empirical answers on the above mentioned problems which remained among regulators and policy makers by utilizing the panel data analysis. Main focus of the research is three fold: First, diffusion of 3G mobile phones in Japan focusing on technological innovations and policies and; Second, diffusion of mobile technology in the world. In both cases, a techno-economic behavior of mobile phone is observed and followed the econometric analysis by focusing on the panel data analysis. Third, an attempt has undertaken to envision mobile cloud applications in South Asia where market potentiality is high.

(a) Diffusion of next-generation mobile phones in Japan

3G technologies in Japan have shown remarkable growth since its introduction in October 2001 by NTT (DOCOMO). As of December, a total of 110.6 million subscribers are achieved by four major mobile operators comprised with 106.2 millions 3G and 4.4 million second generation (2G) subscribers, respectively. In Japan, almost 90 percent populations have access to 3G technologies while the other countries such as in the US or in the Europe the penetration rate confirm only 30-40 percent. Therefore, analysis of Japanese 3G technologies become an important issue with special focus on effect of technological innovations and diversified services.

To measure the significant factors promoting Japanese 3G technologies, the research utilizes the panel data analysis to construct an appropriate econometric model to identify unexplored issues. The econometric approach specifies as the number of subscribers of 3G mobile phone as a dependent variable, while the following three groups of variables (1) GDP and charges, (2) competition policies, and (3) technological innovations are selected for independent variables. The focus is not only on the 3G market as a whole but also on three individual operators such as NTT DOCOMO, au (KDDI) and Softbank. Especially the latter focuses on different strategies of three carriers toward innovations. For appropriateness of econometric model, the monthly data related to 3G mobile phones from October 2001 to December 2008 are used and this is the first attempt to measure empirically the effect of technological innovations and policies on 3G diffusion.

The results have implications on the fourth generation (4G) technologies and eventually on the innovations and services offered to the subscribers, especially when reviewed in the light of predictions made about the future mobile technology requirements. Examples of implications include proper spectrum allocations and bandwidth requirements to maintain 3G services for the countries those who have adopted or thinking to adopt. In sum, the analysis of the Japanese 3G market will provide the basis of the 3G mobile phone in developing economies.

(b) Diffusion of global mobile telephony

The second part of my dissertation concerns the design of global mobile phone adoption in terms of income and services categorization. There are many problems remain in the global mobile phone market comprised with telecommunication infrastructure, technological innovations and country-wide mobile network coverage irrespective of 3G or HSPA. This huge gap is absolutely invisible because of leapfrogging issues in developing countries. Also, some countries have faced problems emerge from operators

to provide better services such as high speed, entertainment or mobile payment services. Although, the diffusion of mobile phone has number of benefits, but there is a huge gap in the uptake between developed and developing countries. Therefore, the dissertation aims to analyze the global mobile phones by examining the instruments stimulating the diffusion pattern.

A rigorous demand model is estimated using global mobile telecommunications panel dataset comprised with 51 countries classified in order to World Bank income categories from 1990-2007. In particular, the thesis examines what factors contribute the most to the deployment of global mobile telephones. To construct an econometric model, the number of subscribers to mobile phones per 100 populations is taken as dependent variable, while the following groups of variables (1) GDP per capita income and charges, (2) competition policies (3) telecom infrastructure (4) technological innovations (5) others are selected as independent variables. The study represents 5 sets of estimations in terms of income categorization.

Estimation results report the presence of substantial disparity among groups. Additionally GDP per capita income and own-price elasticity comprised with call rate, subscription charges, are reported. The analysis of impulse responses for price, competition policies, and technological innovations such as digitalization of mobile network, mobile network coverage indicates that substantial mobile telephone growth is yet to be realized especially in developing countries. A new and important empirical finding is that there are still many opportunities available for mobile phone development in the world pro-poor nations by providing better telecom infrastructure.

Following the same methodology, the dissertation attempts to analyze OECD 3G mobile phones diffusion.

(C) ICT for Envisioning Cloud Computing and Innovation in South Asia

The third focus of the dissertation is ICT deployment in developing countries to meet the recent concepts emerge in telecommunications technology such as cloud computing and connectivity 24/7. Both of these concepts are increasingly emphasized in developed world, but what about developing countries? Therefore, the chapter aims to answer some hypothesis in terms of developing countries potentiality on cloud computing and innovation.

To verify cloud computing implications in South Asia require proper ICT deployment comprised with Internet, fixed phones, mobile phones or personal computers. But the region is highly underrepresented in the use of the ICT. Representing more than 24% of the world population, South Asia accounted for only 4.83% fixed phones, 38.51% mobile

phones, 5.13% Internet users, and 2.1% personal computers as of 2007.

Thus, the framework of the chapter is based on the deployment of ICT in South Asia in relation to the adoption rate of mobile phones, fixed phones, personal computer (PC), and Internet. For instance, the paper utilizes an empirical analysis to find significant factors based on related literature and ICT panel dataset from 1999-2007. Since ICT plays important role to strengthen countries economic performance according to scholars, the study thus focus on how ICT deployment helps South Asian countries to adopt cloud computing concepts and innovations such as web 2.0, health 2.0 or education 2.0. Estimation result presents income, telecom infrastructure and technological innovations play important role for ICT deployment and cloud computing applications.

論文審査の結果の要旨

　本論文は、世界に先駆けて普及した日本の３Ｇ携帯電話の普及過程を、精緻な回帰分析により分析したものである。データとして、３Ｇ携帯電話が発売されはじめた 2000 年以降から分析を行った 2009 年頃までを網羅している。分析手法としては、上記の年次に加えて、NTT ドコモ、au、およびソフトバンクの携帯電話３社を用いるパネルデータ分析である。分析モデルでは、被説明変数としては携帯電話３社の契約者数をとり、説明変数としては、①所得・料金といった経済変数、②３Ｇ携帯電話で可能となった、「着うたフル」といった音楽配信、ワンセグ放送等の新エンターティメント、電子マネー等の e-ペイメント、③高速大容量の通信を可能にした技術、④ナンバー・ポータビリティといった競争政策を挙げている。これが各章を貫く基本的なモデル設計である。

　本博士論文は、７章からなり 147 ページに渡る大著である。第１章は基本的な概念や申請者の分析理念に続いて、関係する先行研究がサーベイされている。第２章では日本の３Ｇ携帯電話の普及過程がパネルデータ分析を用いて行われている。特に、普及を促進した要因として、エンターティメントや電子マネーといった携帯による支払い機能、さらには通信の高速化である。これらの結論は、これまでの先行研究に見られない要因を特定化しているのが特徴である。第３章ではこの分析を携帯電話３社毎の推計を行っている。この分析はこれまで誰もしていない分析であり、チャレンジングな姿勢は評価に値する。第４章と第５章では, 同様のモデルを発展途上国と OECD 加盟国といった発展国で分析している。第６章では南アジアに焦点を当て、かつクラウド・コンピューティングの発展も予測する内容となっている。結論は第７章で与えられている。

　上記の博士論文は、携帯電話の発展について、日本、世界の発展国、さらには途上国というように分析をグローバルに拡張しているのが特徴であり、最先進国である日本をベンチマークにして、他国での発展とを比較すると共に、日本の経験を如何に活かすかと言った視点で統一的に分析されている。ともすれば、ばらばらの論文をエッセィ形式でまとめ上げることが一般的な博士論文にあって、１つのテーマ、１つの分析手法で統一しているものは希有であるといってよい。この意味で極めてユニークな博士論文である。

　各章の質的な側面は強調しなかったが、それぞれが国際的なジャーナルに掲載され、多くの国際学会で発表されてきた。さらには、学会賞や招待講演も行っており、これが本博士論文の質的な高さを証明している。

　以上から、本論文は博士の学位に値するものと判定する。