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Abstract

Countries such as Finland and Sweden have exhibited long-established patterns of leadership in mobile telecommunications in general, while Japan's NTT DoCoMo represents an early national-level exemplar of a major m-commerce business system. The task of identifying and profiling the types of national leadership patterns likely to prevail in 3G wireless networks of Europe, Asia, and elsewhere, however, is a challenging one. This is because new technological and other forces are coming into play in the post-GSM world. In this paper, we present a framework and some evidence to show the potential national leadership patterns in 3G m-business applications in Asia-Pacific, Europe, and Latin America.

Keywords: 3G m-business, mobile phones, leadership, diffusion

Introduction

The sources of national leadership in third-generation (3G) wireless technologies are likely to be significantly different from those in first and second-generation cellular phones. First, new types of network externality effects could be selectively more important for 3G technologies than for lower generation cellular networks. Pre-existing fixed networks created network externality effects for cellular phones. For many 3G applications, however, communications may require end-to-end 3G-connectivity. Such 3G-connectivity could trigger new patterns of network externalities. Second, the penetration and growth rate of cellular phones, the base technology for 3G, varies widely across nations. Conditions for migrating from cellular to 3G may not be uniform across various countries. Third, cellular networks across the world use a plethora of standards. Existing cellular standards across the world vary from first generation (1G) technologies such as Advanced Mobile Phone System (AMPS), Nordic Mobile Telephone (NMT), and Total Access Communication System (TACS) to 2G technologies such as Digital AMPS (D-AMPS), Global System for Mobile (GSM), Code Division Multiple Access (CDMA), and Personal Digital Communication (PDC). Technical difficulties and costs of upgrading these standards to 3G could vary dramatically. Fourth, uptake of data services and the availability of a range of industries that could benefit from 3G technologies are not uniform, even across countries with similar incomes. Fifth, the success of international level initiatives such as IMT-2000 (International Mobile Telecommunications at 2000 MHz) in integrating different standards would influence the diffusion patterns of 3G technologies.

This paper draws evidence from the major economies of three global regions—Asia Pacific, Europe and Latin America—to explore the sources of national leadership in 3G mobile business (m-business) applications. Three sections of the paper follow. First, we contrast the potential sources of national leadership in cellular telephony and 3G applications. Next, we provide some empirical evidence on the influence of national leadership in the diffusion of 3G technologies. Finally, we provide some conclusions.

Sources of National Leadership: Different Generations of Mobile Technologies

While precise definitions vary, *lead markets* entail localized patterns of demand that engender the development of especially innovative or high-quality products in anticipation of trends in other parts of the world.

Various sources of national leadership mentioned in the literature can be consolidated into three basic dimensions: *demand and cost conditions* (Linder 1961; Vernon 1966), *industry structure and competitive rivalry* (Porter, 1990), and *export and transfer conditions* (Beise 2001; Tilton 1971). *Demand and cost conditions* include consumer preferences, income, and input costs as well as government procurement, regulatory regimes (affecting cost), and prior national experience with previous generations of technology. *Industry structure and competitive rivalry* are particularly important in fast-moving high-tech industries where pampered national champions rarely achieve international competitiveness. Competitive rivalry also includes the participation of foreign firms. Finally, a variety of *transfer and export conditions* affect the capacity of dominant designs developed in the national market to supplant competing designs in global markets. These include trade policy, the export orientation of industry, strategic regulation, and market size. The *lead effects* influence the diffusion of new technologies by various mechanisms (Beise 2001).

Table 1. Possible Influences of Various Factors on the Diffusion of Different Generations of Mobile Technologies

Factor affecting diffusion	Role of this factor in:	
	Diffusion of 1G and 2G technologies	Diffusion of 3G and 4G technologies
Demand and cost conditions	• Pre-existing wired phone penetration influenced the demand of cellular phones • Early adopter countries discovered more market sectors and more applications • Relative price structures of fixed and cellular networks influenced the demand of cellular phones.	• Already achieved penetration rates of cellular phones • Uptake of data services • Market size: diversity and size of industries likely to use 3G applications • Special network externality effects due to 3G-to-3G communications
Industry structure and competitive rivalry	• Pre-cellular and cellular competition influenced prices of calls and phones, and the availability new services and applications. • Promotional activities of competitors attracted new customers	• Some upgrades likely to be simpler/cheaper than other upgrades (e.g., simpler upgrade from existing CDMA-based 2G networks to CDMA2000-based 3G networks). • Rivalry in cellular networks and new rivalries in 3G applications
Export and transfer conditions	• Export orientation of firms (e.g., those from Nordic countries) facilitated the diffusion by lowering prices. • Linguistic and cultural contexts and physical conditions of a country influenced the suitability of cell phones designed in another country. • International roaming ability, features to address the needs of diverse countries, and non-proprietary status facilitated the diffusion of the GSM standard.	• Language, culture, and ties with rest of the world could influence 3G m-business applications. • ITU's IMT-2000 (International Mobile Telecommunication 2000) standard could ensure the compatibility and interoperability of different systems (such as CDMA, GSM, and TDMA) in 3G. • G technologies would eventually offer worldwide roaming facility.

The economies across the world differ widely in terms of the sources of leadership discussed above and various other factors influencing the diffusion of mobile technologies. Moreover, the characteristics of different generations of mobile technologies tend to interact with the characteristics of an economy making a certain generation of mobile technology more attractive than others.[1] Table 1 contrasts the roles of various factors along the three dimensions discussed above in the diffusion of different generations of mobile technologies.

Whereas cellular phones diffused faster in smaller Nordic countries than in bigger EU countries, there are reasons to believe that 3G technologies are likely to exhibit different diffusion patterns. First, the large number of possible applications for 3G – advertising, business data, email, information services, SMS, transactions, machine-to-machine, multimedia, voice (Johansson

[1]For instance, the first generation (1G) mobile phones are analog transceivers designed purely for voice calls. Second generation (2G) mobile phones use digital technology. 3G mobile phones use packet switching instead of circuit switching and hence there is no need to establish a continuous connection that dedicates a circuit for each call. Such packets contain a destination address and a sequence number and can be independently routed and reassembled into a complete message. 3G mobile phones also have much higher data transmission rates. 4G mobile data are planned to have still higher transmission rates, as high as 20 mbps.

2001)– could favor large countries with diversified industrial bases. Automobile and manufacturing applications in Germany, financial and service applications in the UK, Internet-based consumer electronics (games, music, etc.) in Japan – these could provide fertile contexts for 3G-mobile experimentation. Second, new network externality could be associated with the diffusion of 3G technologies. For instance, before global interoperability is achieved, only 3G devices would exploit combined voice/picture capabilities of 3G networks. Conventional mobile phones and many PCs could be excluded from such application networks. In EU, for example, Germany – the largest national market with 83 million inhabitants and very competitive industries (Pavitt and Patel, 1999) – could be the breeding ground for such new externalities. This paragraph can be summarized with the following hypothesis:

> H_1: *Ceteris paribus, the diffusion of 3G technologies is positively related to the market size.*

Third, factors related to *industry structure and rivalry* will influence the diffusion of 3G technologies. For instance, *both* the UK and Germany are distinguished by *high rivalry* in 3G markets. Vigorous 3G license auctions in these two countries clearly reflect this. While NTT DoCoMo is the only significant 3G operator in Japan, it has promoted intense rivalry among m-commerce application providers and device makers. Also, countries that have based their cellular networks on CDMA – South Korea, Brazil, India and Mexico – could benefit from smoother, less expensive transition to one of the rival 3G technologies, CDMA2000 or W-CDMA (The Economist 2002). On the other hand, countries using GSM standard could be slowed down by the requirement to build new 3G networks from scratch. Thus:

> H_2: *Ceteris paribus, 3G technologies would diffuse faster in economies that have based their cellular networks on CDMA than those using GSM standard.*

Fourth, various *export and transfer conditions* influence the diffusion of 3G m-business. For instance, language and cultural ties closely link the English-speaking world to the UK. Also, given the extensive hosting of non-European multinational companies by UK, it will almost certainly serve as a beachhead for North American and Asian firms anxious to participate in and learn from European 3G networks. Similarly, international level initiatives such as IMT-2000 – designed to promote compatibility and interoperability of different cellular standards – are likely to have differential impacts on the diffusion of 3G technologies in various parts of the world.

Some Empirical Evidence

The regression results in table 2 with 3G-license fee per capita[2] as the dependent variable (DV) indicate that market size (measured by population size: POP) plays an important role in the potential leadership of 3G m-business. 3G license fees are available only for 22 economies, mainly high income ones, which are included in the regression analysis as the dependent variable. A comparison of the per capita 3G license fees for the countries shown in table 3 also reveals several interesting trends. The 3G license fees per capita are much higher in the bigger EU countries such as Germany, UK, France and Italy than in the smaller EU countries. In Asia, the fee is much higher in South Korea than in other smaller countries in the region. Whereas penetration rate of fixed phone (FIX) has significant effect on the diffusion of first and second generation (1G+2G) mobile phones, fixed (FIX) as well as mobile (MOBILE) penetration rates do not have significant effect on per capita 3G license fee. The income variable has no significant effect on any of the regression models (Table 2).

Second, examination of 3G license fees per capita in comparable-sized countries (in population terms) such as New Zealand and Singapore, and Spain and South Korea, indicates that penetration rates of regular cellular phones, income levels, and prior cellular standards may influence the 3G potential of the country. For example, South Korea's substantially higher licensing fee than Spain's is possibly due to its high-penetration 2G network that uses the CDMA standard – easily upgradable to CDMA-based 3G standards.[3] Similarly, Singapore's substantially higher licensing fee than New Zealand's is probably due to substantially higher per capita income and cellular penetration in the former.[4]

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[2]We have taken license fee per capita as a proxy for the leadership in 3G m-business.

[3]The 3G rivalries are comparable in these two economies. For example, South Korea awarded three 3G licenses (winners: KTICOM, SK telecom and LG Telecom) whereas Spain awarded four (winners: Telefonica Spain, Airtel, Amena, and XFERA).

[4]The 3G rivalries are comparable in these two economies. For example, New Zealand awarded four 3G licenses (winners: Telecom NZ, Vodafone Mobile NZ, Clear, Telstra Saturn) whereas Singapore already awarded three (to SingTel, M1 and StarHub) and is planning to offer one more.

Third, low-income countries in Asia and Latin America have very low penetration rates of cellular phones. Most of them lack the diverse range of industries likely to use 3G technologies and the uptake of data services is very slow in these countries. These factors explain the low 3G potential in these countries. Major Asian and Latin American countries such as India, China, Philippines, Thailand, Uruguay, Colombia and Mexico have not yet started the auction for 3G licenses.[5] Similarly, receiving no viable bids, Brazil canceled 3G auctions twice in 2001.

Table 2. Factors Influencing the Diffusion of Different Generations of Mobile Technologies: Regression Results

Intercept, Indep. Var.	Dependent Variable		
	1G+2G PENETRATION	3G LICENSE PER CAPITA	3G LICENSE PER CAPITA
CONSTANT	-11.24 (-0.19)	-250.9 (-1.29)	-193.6 (-0.96)
POP	-0.019 (-0.22)	**3.01 (2.57)** [a]	**2.84 (2.41)** [a]
GNP	0.002 (0.37)	-0.004 (-0.69)	-0.004 (-0.62)
FIX	**0.75 (3.07)**[a]	0.72 (1.41)	0.88 (1.66)
MOBILE			-0.34 (-1.05)
R^2	0.72	0.31	0.35
N	32	22	22

Note: T-values are in the parentheses.
[a]Significant at 0.05 level

Conclusions

The analysis of this paper indicates that the mechanisms by which technological, political, and other environmental forces influence 3G m-business are significantly different from the mechanisms that influenced the diffusion of lower generation cellular phones. While small Nordic nations such as Sweden and Finland pioneered in mobile telephony, large and affluent European and Asian nations – Germany, UK, Japan – will probably spearhead the innovation process for 3G devices and applications.

References

Beise, M. *Lead markets: Country-specific success factors of the global diffusion of innovations, 2001,* Heidelberg: Physica-Verlag.
Johansson, P. "The future is here," *Pacific Telecommunications Review*, (22: 3), 2001, pp. 21-31.
Linder, S.B. *An essay on trade and transformation, 1961,* Uppsala: Almqvist & Wiksells.
Pavitt, K. and Patel, P. Global corporations and national systems of innovation: who dominates whom?" In D. Achibiugi, J. Howells, and J. Michie (eds.), *Innovation policy in a global economy*. Cambridge: Cambridge University Press, 1999, pp. 94-119.
Porter, M. *The competitive advantage of nations,* 1999, London: MacMillan.
The Economist. "Business: 3G by any other name, Mobile telecoms," January 12, 2002, p. 72.
Tilton, J.E. *International diffusion of technology: The case of semiconductors.* Washington, D.C.: The Brookings Institution, *1971.*
Vernon, R. "International investment and international trade in the product cycle," *Quarterly Journal of Economics,* **80**, 1966, pp. 190-207.

[5]It should be noted that mobile markets in many of these countries are characterized by high competitive rivalry.