Lead Markets:
Drivers of the Global Diffusion of Innovations

Marian Beise

Zentrum für Europäische Wirtschaftsforschung (ZEW), Mannheim, Germany,

Research Institute for Economics and Business Administration, Kobe University, Kobe, Japan

Abstract. Multinational corporations are often faced with regionally varying market conditions, local environments and demand preferences. This paper presents the lead markets concept of developing global innovation that takes advantage of the lead market phenomenon. A lead market is a regional market that is first to adopt global innovation designs. A system of five lead factors explains the lead role of a market: a demand advantage, a price advantage, an export advantage, a transfer advantage and a market structure advantage. The system of lead market factors is then evaluated in a detailed case study of the cellular mobile telephone industry. It is suggested that companies can harness lead markets for the development of global innovations. By developing and refining innovations in close interaction with the local environment of a lead market, a company can focus on a narrow range of preferences and feedback, lowering the risk of being locked into idiosyncratic environments, and generate true global innovations.

Key words: international diffusion of innovation, R&D internationalisation, market entry strategy

Corresponding Address: Kobe University, RIEB, 2-1 Rokkodai, Nada-ku, Kobe-shi,
Email: rian@rieb.kobe-u.ac.jp

1. Introduction

A common problem of an international company's innovation development is that it has to select from different technical specifications, technologies, and innovation designs that best fit the preferences of the users. However, the users' environment and the market context often vary considerably from country to country, each requiring different attributes of an innovation. While one technology is better suited to one country, another has its merits predominantly in another country's environment. This varying landscape of the global market can lead to regionally fragmented markets with regional standards and different product and process designs. There are, for instance, considerable differences between the automobile markets in the US, Europe and Japan which force most global automobile companies to develop cars for each region separately in order to gain a major market share.

Yet it can also be observed that, over time, an initial variety of regional innovation designs culminates in an international standardisation process in which a globally dominant design emerges. Global innovations such as the fax machine, cellular mobile telephony or the Internet have gained dominance in their respective product domain although a persisting coexistence of innovation designs was expected. To become internationally successful, innovation designs often have to squeeze out rival designs previously preferred by the users of other countries. For instance, in the 1980s the fax machine was favoured by Japan before it superseded telex, which was initially preferred in the Western world. Many auto safety devices, such as the airbag and anti-lock braking systems (ABS), have become standard equipment in most countries overcoming initial resistance after the German market took the lead. The European cellular mobile telephone standard (GSM) became adopted worldwide although the US and Japan initially favoured different technologies or standards of mobile telephony.

Companies that responded to markets that initially favoured an innovation specification that has since become the globally dominant design successfully leveraged their home market advantage into global market leadership. On the other hand the success of other local innovations was short-lived. Companies

that concentrated on the preferences of an idiosyncratic regional market found themselves locked into an innovation design that became squeezed by the emerging globally dominant design.

Models of competing innovation designs suggest that it is often impossible to predict which design will become the dominant design (Arthur 1989, Cowan 1991, An, Kiefer 1995). Looking at the international diffusion of innovations there are nation-specific factors which are not included in those general models but which can explain why an innovation design initially refined to a local market became a global dominant design. This paper suggests that the ability of an innovation design to diffuse internationally and squeeze out other locally preferred designs is positively correlated with attributes of the country that first adopted that design, i.e. the lead market. A model of nation-specific attributes is proposed that render a country a lead market and illustrates this with a case study of cellular telephony. It suggests that lead markets can help companies seeking to develop global innovations as a forecasting laboratory. Lead markets can help predict the international innovation design. A lead market can also be used as a test market for a global market launch. Innovations that have been successful with local users in lead markets have a higher potential of becoming adopted world-wide than any other design preferred in other countries. After identifying the lead market potential for a specific innovation, international companies can follow a global standardisation approach to innovation development even if demand preferences initially vary internationally. Responding to lead markets can guide a firm to generating globally successful new products and processes.

The paper is structured as follows. First, the lead market phenomena observed are carefully defined. Second, an eclectic theory of lead markets is suggested based on economic consumption theory with and without perfect knowledge of user preferences. The theoretical arguments are then classified into five groups of country-specific attributes that can render a country a lead market. Third, these theoretically derived lead market factors are used to explain the international diffusion of cellular telephony. In the last section I look at how companies can harness lead markets as a source of new global innovation design. A model for estimating lead market potential is suggested in order to predict lead markets ex ante.

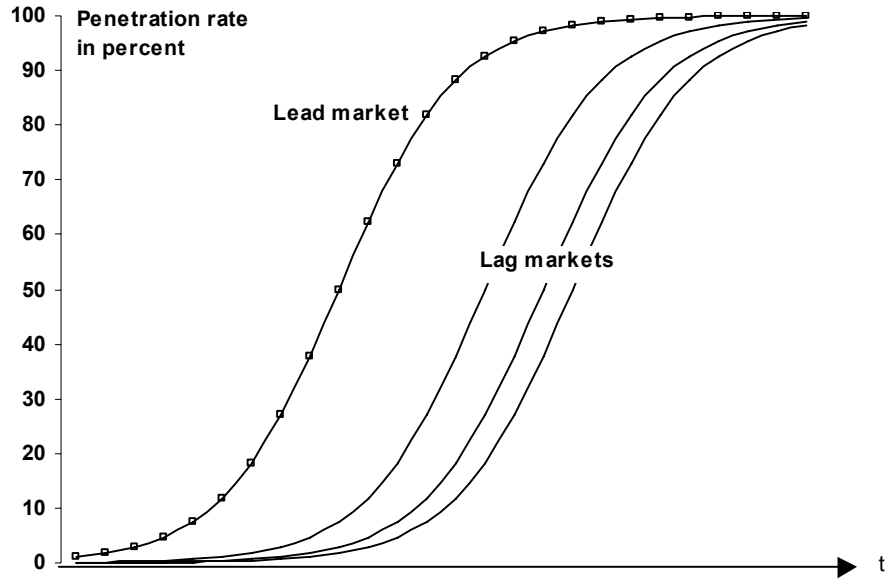
2. Definition of Lead Markets

The global innovation diffusion process of products or processes that have achieved global dominance regularly starts in a particular country or region. Figure 1 depicts the commonly observed pattern of the international diffusion of a globally successful innovation.[1] Countries which are first to adopt a globally successful innovation have been called 'lead markets', countries that later adopt the same innovation 'lag markets'. The term 'lead market' has been used in various ways in literature in the past. In the definition used by most diffusion researchers a lead market is a country in which the diffusion process of an innovation first takes off (e.g. Kalish et al, 1995, Kotabe, Helsen 1998). Other authors have used the term 'lead market' to denote the country in which an innovation was invented (Yip 1992), in which a subsidiary of a multinational company takes over global product responsibility, for instance as global coordinator of marketing activities (Raffée, Kreutzer 1989), or as a mixture of all (Jeannet 1986).

Lead markets have previously been characterised as having the most innovative customers, i.e. customers who are most open to new products, most willing to adopt early and risk the failure of an innovation (e.g. Albach 1993). Takeuchi and Porter (1986) as well as Johansson and Roehl (1994) define lead markets as markets with the most demanding buyers or those buyers most likely to adopt innovations anticipating a continuous flow of new products incorporating state of the art technology. However, this previous characterisation of lead markets as the most inventive or innovative country neglect the whole story of the global success of an innovation.

[1] Although the slope of the diffusion in each country is depicted in the figure as being the same, it is not claimed here that they actually are. Studies on the rate of diffusion as a function of the time lag are ambiguous on the question of whether the diffusion rate of lag markets is lower or higher than that of the lead market (e.g. Ganesh et al. 1997, Takada, Jain 1991).

Figure 1: The international diffusion pattern of an innovation design



The diffusion pattern of an innovation cannot be explained solely by the willingness to adopt innovations or by international technology gaps. First, lead markets are not only characterised by the early adoption of an innovation, but by the fact that countries that adopt the same innovation follow them. There are far more innovations that were successful in one country at an early stage of the technology but that then failed internationally than there are globally successful innovations. Innovations are adopted only by a few countries for instance because the market demand or cost situation happened to be idiosyncratic, not matched by other markets' context. For example, many years before the commercialisation of the Internet, an online system called Minitel diffused rapidly within France in the early 1980s (Kramer 1993, Rogers 1995) but it was not widely accepted in other countries, where the Internet finally became the global standard in the 1990s. These innovative but idiosyncratic markets are not lead markets because no other market follows them in adopting the same innovation design. It is therefore not only the openness to innovation that defines a lead market, but the selection of innovations that are subsequently demanded worldwide.

Second, it is not originally the regional origin of inventions or supply constraints that causes this pattern. Whereas the emergence worldwide of an application is initiated in one country or region, the invention on

which the innovation is based often originated in another country. The first personal computer was according to the Boston Computer Museum not invented in the US, where adoption leads the world trend, but in France. Cellular mobile telephony was invented in the US but first successfully introduced in Scandinavia. The same thing happened to the fax machine, which Japan adopted first. The anti-lock braking system itself was developed for aircraft in the US and the UK but Germany was first to adopt the technical concept as auto equipment. Furthermore, availability of an innovation is not exogenous to being able to explain the order of adoption. It can be assumed that, once technology is discovered, the local availability of innovation is mostly a function of demand derived from the local utility of an innovation. The country-specific adoption pattern of an innovation can then be explained by international differences in the market factors that determine the adoption of an innovation and vary from country to country. The country adopts an innovation first where the adoption stimuli (such as perceived benefit, budgets and prices) are highest. When the adoption stimuli increase globally over time, more and more countries adopt the same innovation.

In some cases, an innovation fails in a country until another country adopts it. It seems that a country is able to invoke a change in adoption stimuli required to get other countries to adopt the innovation as well. The fax machine, although invented in 1843 and continuously improved upon since then by many companies in advanced countries such as the United States and Germany, remained in niche applications until a mass market emerged in Japan in the early 1980s (Peterson, 1995, Coopersmith, 1993). This mass application was not confined to the Japanese market for long, spreading to the United States and later to Europe within a few years. Today, the fax machine is seen worldwide as an indispensable means of text communication. Competing technologies, which initially had been successful at a local level, such as telex, which Western markets originally favoured, either vanished or were confined to minor applications.

The examples show that the global diffusion of an innovation is accompanied by the competition of alternative innovations designs, each preferred by different countries. With the term ‘innovation design’ I follow the broad usage by Utterback (1994). An innovation design is a specification or configuration of an

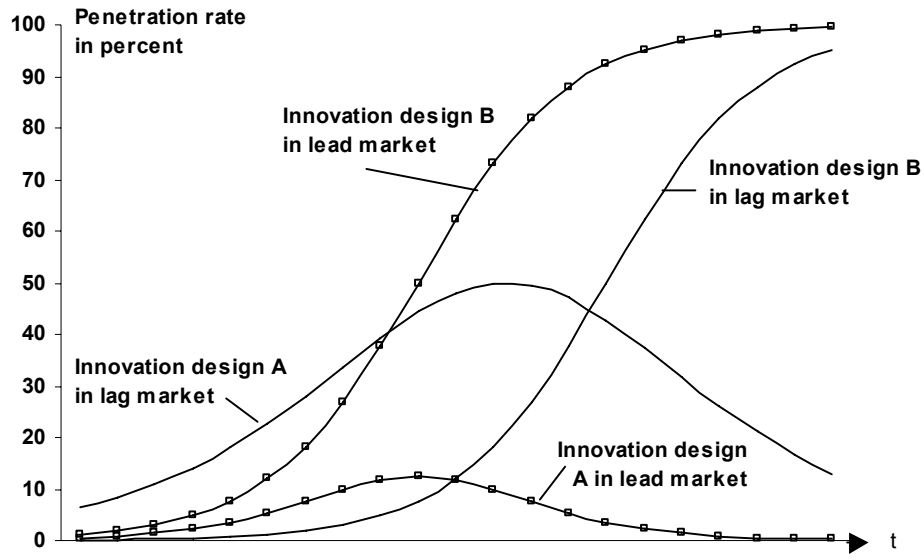
innovation idea. Different designs of an innovation have the same basic function but different specifications or a different mix of attributes such as size, quality performance, precision, technology, energy consumption etc. Different designs are characterised as alternatives for the same need or function and that they therefore compete against each other on the world market. For instance, the fax machine is an innovation design of a communication device transmitting written information. An IBM and an Apple computer are different designs of a personal computer. An innovation is often a different design of an older product or process and it often competes against the older products in the market because the older design still has its reasonable merits for some users.

Competition between innovation designs occurs on different levels but the definition shall be independent of the level of analysis. The GSM cellular telephone competes against other cellular mobile telephone standards as well as against pagers. All are different designs of mobile communications. Different designs of a nuclear reactor compete, so does nuclear energy against wind energy. Therefore, the term 'design' used here encompasses not only a technical specification but also software, a formula such as a soft drink, a technology or even a technological trajectory. For instance, the lead market for wind energy usage is Denmark (Beise, Rennings 2003). As a result, the technical development path from generator generation to generator generation, starting with small generator types in the 1980s to bigger ones in the 1990s, became globally dominant. Germany, however, failed with large generators in the 1980s and succumbed to the Danish approach.

Based on the examples given, an extended pattern of the international diffusion of innovations can be derived that incorporates competing innovation designs (Figure 2). Two countries, a lead and a lag market, initially favour two different innovation designs A and B. Only design B, favoured by the lead market, becomes adopted in the other market, the lag market. Design A, initially preferred by the lag market, is squeezed out of the market. The cross-country diffusion pattern of design B resembles the common diffusion pattern depicted by Figure 1. The lag market in this pattern is not a country that adopts innovations late, but that adopts the dominant design late. For instance, France adopted an online service

as early as the 1980s but was late adopting the Internet itself, which makes it a lag market of the Internet revolution. Countries that have a high willingness to adopt innovations but that adopt innovation designs that do not become globally adopted might more appropriately be called 'idiosyncratically innovative' countries.

Figure 2: A generalised pattern of the international diffusion of innovations with competing designs



In this paper, lead markets are described as Bartlett and Ghoshal (1990) define them. They use the term lead markets in the context of the ability of these markets to stimulate global innovations, as geographical markets which have the characteristic that product or process innovations induced by local demand preferences and local environmental conditions can subsequently be introduced successfully into other geographical markets and commercialised world-wide without many modifications. This refinement leads to the following hypothesis on the existence of lead markets:

There are nation-specific demands and market contexts that support the adoption of an innovation design that is subsequently adopted by other countries, the lag markets, even if the lag markets have previously preferred or adopted different innovation designs.

A market context includes not only customers and their preferences and budgets but also all other actors that might pull the development of innovations and influence the market selection process, such as competitors, suppliers and auxiliary institutions like banks. The lead market hypothesis challenges the argument that the adoption pattern originates from a technological knowledge lead of a country. The last part of the definition is a reminder that lag markets are not defined here in the conventional sense as countries unwilling to adopt innovations before others have done so.

The main purpose of the next section is to explain the lead effect of a country, i.e. the ability to elevate its preferred innovation design to global dominance. Based on the reasoning of simple economic consumption theory there are several nation-specific factors that can explain the extended pattern of the international diffusion of an innovation. Those national advantages do not necessarily correlate with the innovativeness of a country, which is the willingness of a country to adopt innovations. Instead, they describe nation-specific attributes that make the selection process among innovation designs less idiosyncratic and make it more likely that the chosen innovation design becomes internationally successful. Knowledge about the ability of countries to select innovation designs that have a better chance of becoming global innovation designs is very valuable to companies as they can redirect their innovation activities towards these lead market countries and avoid countries with idiosyncratic preferences. I will address the managerial implications in the last section.

3. A Theory of Lead Markets

The national order of the adoption of an innovation has already been studied by Gatignon et al. (1989), Dekimpe et al. (1998a/b), Poznanski (1983), Takeda, Jain (1991), Antonelli (1986), Ganesh et al. (1997). However, these studies do not include the adoption of a competing technology or design by other countries. The adoption lag between countries is seen to depend on the innovativeness of countries. To support the existence of lead markets, one must clarify theoretically why an innovation design that is

preferred in one country becomes adopted globally even when other countries have to abandon their previously preferred designs. The following section discusses several economic explanations for the international diffusion pattern introduced above. The first line of argumentation is derived from a simple comparative static adoption model; the second includes knowledge imperfections and the influence of other market actors, such as competitors, suppliers and banks on the innovation behaviour of companies. All arguments that can be derived from the market context as opposed to the technological knowledge related argument are then classified into five groups of lead market advantages. These five factors are attributes of a nation's market that can render a country a lead market: a demand advantage, a price advantage, a transfer advantage, a market structure advantage and an export advantage.

3.1 Economic reasons for lead markets

Let us consider two countries initially preferring different product designs. It is assumed that both countries have the same general willingness to adopt an innovation. The two designs represent either an innovation competing with an established older product or they represent two different designs of an innovation competing against each other. The former case describes the simple situation of the adoption of an innovation that was introduced to substitute an established product. The latter case describes two nation-specific innovation designs competing to become the globally dominant design. Within the modelling framework of the economic theory of consumer behaviour (e.g. Deaton Muellbauer 1980), different consumption patterns in the countries can be a result of (1) different budget constraints, (2) different preferences, i.e. different properties of goods are preferred because of varying environmental context or tastes, and (3) different prices of the goods in the two countries.

After a period of time both countries prefer the innovation design that was preferred initially by one country, the lead market. There can be three general reasons for the other country, the lag market, changing its adoption pattern: (1) the available budget of users in the lag country could have increased, (2) the relative benefit of the product adopted in the lead market for users in the lag country could have increased, and (3) the relative price of the product in the lag country could have decreased.

Based on this typology of changes of adoption stimuli, three basic lead market mechanisms can be derived. First, even if preferences are equal, a difference between the average income of potential users in the two countries causes a superior product to be adopted earlier in the lead market than in the lag market. This is the main explanation given in the classical international product-life-cycle theory by Vernon (1966). I call this the income-lead effect within the category of demand anticipation advantages. Anticipatory demand means that the lead market yields a high relative benefit of an innovation design that later emerges for users in other countries as well and drives them to adopt the same innovation design, which is the second basic mechanism. A country renders anticipatory demand that is at the forefront of an international trend that changes the utility of specific innovations. This is what Porter (1990) calls a demand advantage of a country and how Bartlett and Ghoshal (1990, p. 243) explain lead markets: "local innovation in such markets becomes useful elsewhere as the environmental characteristics that stimulated such innovations diffuse to other locations".

In addition, preferences in the lag market could be influenced by consumer choices of users in the lead market. For instance, adoption reduces uncertainty about the benefit of an innovation design. The demonstration effect is considered an important mechanism of diffusion (Mansfield 1968). Potential adopters in a lag country observe the success of the innovation in the lead market, triggering a high adoption rate in the lag country. Reputable first adopters of an innovation signalling the credibility of an innovation can further reduce the risk of adoption. In the next section, the income-lead effect and the trend based anticipatory demand effects are summarised as demand advantage, whereas these interaction effects between countries are categorise separately as transfer advantages of a country.

And third, a relative price reduction of the design preferred in the lead market for users in the lag market shifts consumption in the lag market away from the previously preferred design towards the design preferred in the lead market. This price mechanism can be further divided into two sub cases. The price of the lead market design is initially lower in the lead market than in the other market, but the lower price becomes available over time in the other country as well. An external price trend inducing the

internationalisation of an innovation can be called anticipatory prices or the price-lead effect. Second, even if prices are the same internationally, but preferences differ internationally, one innovation design becomes adopted by both countries if the price of the design preferred in the lead market decreases in relation to the prices of designs preferred by the other country. This can be called the price reduction effect, which is the main argument of Levitt's (1983) famous "globalisation of markets" hypothesis. He asserts that global producers “attract customers who previously held local preferences and now capitulate to the attractions of lesser prices”. This describes a simple substitution effect: innovation designs that become more expensive are replaced by innovation designs that become less expensive in the lag markets.

There are two additional arguments for the internationalisation of innovations designs that are not conveyed by this simple model. First, companies not only respond to local preferences but to customers abroad and other local market participants as well such as competitors, suppliers or banks that might push them to develop exportable innovations. A design adopted in one country has a better chance of becoming the globally dominant design if it already incorporates features that enhance its utility in foreign markets so that the lead market design is as beneficial or almost as beneficial in the lag market as the domestic design of the lag market. Export orientation can evolve into a global market orientation through foreign direct investments. A country in which demand and institutions support the export or global market orientation of local innovations can therefore become a lead market.

Second, when preferences are not perfectly known, different companies offer alternative designs in the market. Testing and evaluating different designs increases the likelihood of finding the technological design that is the most beneficial and the likelihood of discovering new applications for a specific design. However, in a country in which for instance a monopolist selects and offers only one design on the market, this design is unlikely to best suit local preferences. The core argument here is that the trial and error selection process among different designs in one country may lead to the domestic selection of an innovation design that is even more beneficial than the local design adopted in another country with a less competitive market environment. The initial choice of the lag markets then does not reflect the local

preferences but results from the initial unavailability of the better alternatives offered in the lead market. A country with more local competitors or tougher competition is therefore more likely to find a design that is beneficial both to itself and many other countries as well which then becomes the globally dominant design. Competition was indeed suggested before as a national competitive advantage (e.g. Porter 1990, Mowery 1995, Sakakibara, Porter 2001).

3.2 A system of lead market advantages of countries

Based on theoretical reasoning, nation-specific attributes for the lead market role can be identified such as per capita income, size of country, reputation and so on. In this section these nation-specific characteristics are classified into five groups of lead market advantages. This makes the concept easier to assess for empirical work since the parameters in the consumption model are, for the most part, not easily observable in reality. Five groups of lead advantages can be identified for a country: these can be called lead market factors, as the determinants of the international diffusion of a domestically preferred innovation design: (1) price advantages, (2) demand advantages, (3) transfer advantages, (4) export advantages and (5) market structure advantages. The groups are not necessarily uni-dimensional because each one comprises a multitude of sub-factors that could be unrelated or even contrasting. An applicable lead market theory is therefore rather an eclectic theory than a mono-causal model focussing on a presumed main internationalisation mechanism. The approach followed here is to integrate all possible international mechanisms.

3.2.1 Price and cost advantages

The simplest means to overcome international demand differences is a relative price decrease of one innovation design. A lower price can be realised by lower costs. Relative price reductions are mostly based on economies of scale of mass production thus giving the country with the biggest market for an innovation a cost advantage. Large countries therefore have a cost advantage, but it is not always the population that determines the size of the market. For specialised high-tech products with few applications, small countries can also offer a sufficiently large domestic market (Kravis, Lipsey, 1971). A mass market

can emerge in a country or region relatively small in terms of population, because innovations are frequently not initially designed for the mass market but to fit a niche market. They can later be refined and adapted for the mass market, either deliberately or because a mass market happens to emerge due to previously unrevealed consumer preferences. In addition to size, market growth has a cost effect. The cost of a new technology is higher for the potential adopter if existing production techniques have to be replaced than if new capacity has to be deployed. In addition, faster growth will lower the risk of producers making full use of new investments (Porter 1990).

As noted above, another cost advantage can result from staying at the forefront of an international trend in factor prices, such as input factors for the production or complementary factors for the utilisation of a specific product, such as petrol for a car or videocassettes for a video recorder. When a country foreshadows global changes in factor prices it can adjust to the new factor cost earlier than other countries. The cost advantage can result from increasing or decreasing factor prices. First, an innovation of universal appeal is normally adopted to a greater extent in a country where it costs less. A global price decline spurs its international diffusion. Even if preferences vary internationally favouring different designs, an innovation design that uses an input factor in production or for usage which over time becomes cheaper internationally would gain appeal in foreign countries over local innovation designs that use other input factors instead. Second, a cost advantage can result from increasing factor costs when rising factor prices induce innovations that initially are country-specific but later meet global market needs. For example, a country where labour costs are at such high levels that machinery companies concentrate their innovation efforts on automating machinery will be a lead market if labour costs in other countries follow the trend of increasing relative to the cost of other factors.

The price advantage is expected to be one of the strongest lead market drivers, because large price reductions or global factor cost shifts were a characteristic of the emergence of a mass market for many global innovations. The fax machine, the Internet and the personal computer became much cheaper over time than their respected alternatives and that paved the way for their global market success. The

importance of this effect will be demonstrated below again using the specific example of cellular mobile telephony.

3.2.2 Demand advantage

National conditions that result in the anticipation of the benefits of an innovation design emerging at a global level can explain why a country adopts a specific innovation design before other countries do so. In general, anticipatory needs of domestic buyers are needs that will subsequently emerge and prevail in other countries as well. If changes in demand are a global trend, the demand for innovations responding to the trend will emerge first in those countries where the change first occurred or where the trend is most advanced. In the past, the dominant global trend that explained a lead market was increasing income (Dekimpe et al. 2000). Countries with high income per capita are the first to experience what later will be global demand since income increases over time in most countries, producing the same preferences worldwide with a time lag. The international product life cycle suggests that major innovations were developed in the US in the first half of the twentieth century because income per capita in the US was the highest in the world (Vernon 1971). As other countries caught up and reached the level of income per capita present in the US at the time of the innovation, the same demand for the new product emerged in these markets as well. However, convergence between the large industrialised countries now means that differences in income per capita are marginal. Today, other global trends are responsible for the global diffusion of innovations. Trends can occur in technological, economical, ecological, social and environmental contexts. Innovations responding to these trends, easing its disadvantages or make use of its advantages, are adopted first in countries that are most advanced in the trends offering the highest benefit of the innovation.

The availability of complementary assets can also be a global trend that induces the global diffusion of innovations. The creation of complementary assets is not always a direct response to the introduction of innovations. Complementary assets that have been designed for other applications can nevertheless facilitate the adoption of innovation designs not directly related to them. Complementary goods can

include information and telecommunication infrastructure, retail networks and other types of infrastructure. Innovations use these general assets. For instance, credit cards facilitated purchases via the Internet. Countries in which credit cards are more common have a lead in the adoption of e-commerce services over other countries in which credit cards are slowly taking off.

Lead markets share the feature of the demand advantage with lead users suggested by von Hippel (1986). Although lead users are different from lead markets in that lead users are innovators that use their innovations, a trend is also the main diffusion mechanism that prompt other users follow the lead users. Lead users are users who "face needs that will be general in the marketplace – but face them months or years before the bulk of that marketplace encounters them" (von Hippel 1986, p. 786). Von Hippel suggests trends of environmental conditions or technology as the diffusion mechanism. The trend is considered to explain why other users follow the early users in adopting the innovation.

Yet, it is often difficult to find a global trend that is responsible for the international diffusion of an innovation and one is prone to confuse the internationalisation process itself with the trend. There are no obvious trends behind the global success of the fax machine, the Internet or the personal computer. A demand advantage is expected to be less relevant for many lead markets.

3.2.3 Transfer advantage

Another international diffusion mechanism is when the adoption behaviour of customers of foreign markets is influenced by the adoption of an innovation design in the lead market. The adoption of one innovation design in one country increases the perceived benefit of an innovation design in another country because it lowers the uncertainty associated with an innovation. For instance, the perceived benefit of an innovation design increases when information on the usability of the innovation design is made available for users abroad. Information on the innovation not only enhances the awareness of the innovation design but also reduces the uncertainty surrounding new products and processes. In the international diffusion of innovation context, the "demonstration effect" becomes an international "lead effect" (Kalish et al. 1995). International diffusion of durable goods thus depends on the intensity of

communication between two countries (Takada, Jain, 1991). Putsis et al. (1997) show that the number of cross-border communication ties are not equally distributed among nations and are not symmetrical. A case study included in Nabseth and Ray (1974, p. 115) demonstrates that users get information on innovations of a product domain from preferred countries. The reputation and sophistication of a user in one country can be a signal for the quality of an innovation design for users in other countries. Another transfer advantage previously noted by Porter (1990) and Douglas and Wind (1987) is when the preference of a country for a design can be actively transferred abroad, e.g. by businesspersons, military and tourists. This transfer effect can stem from multinational companies as well. They have an incentive to use standardised equipment in all subsidiaries, which creates demand for foreign innovation designs.

Proprietary innovation designs are often disadvantaged in international diffusion against non-proprietary designs. First of all, non-proprietary standards can be imitated by other companies and therefore disseminated on a wider scale (Anderson, Tushman 1990). Second, proprietary standards are expected to improve less over time than non-proprietary or open designs. Open designs can be more easily improved by many other producers and users, not only by the company that owns the property rights of a design. Third, the willingness to adopt a foreign design often decreases with an increasing degree of property of technology. Nations are often reluctant to support a standard that is seen as the property of a foreign company.

Network externalities can also increase the benefit of an innovation design across countries making an innovation adopted abroad more attractive for users than the indigenous design. However, while a factor that drives the adoption of innovations of many high-tech products (Varian 2001), externalities are unlikely to be as dominant in the international diffusion of innovations. For instance, the number of fax machine users in Japan did not increase the benefit of the fax in the US since very few Americans communicate with Japanese. While externalities can drive the diffusion of a dominant design within a country, squeezing out local innovation designs in foreign countries necessitates cross-country externality overcompensating for local externalities within a foreign country. This requires strong interaction between

actors of different countries. The worldwide success of the Internet could have been based on this effect. Countries that used different online protocols, such as France, slowly switched from the homegrown system to the Internet.

3.2.4 Export advantage

It is also an important national advantage when local market participants guide companies or the local market context to increase the exportability of nationally preferred innovation designs. With knowledge about foreign market conditions, an innovator is able to design its innovations to suit not only the local environment but also foreign environments as well through the incorporation of additional features. Three factors can deliver an export advantage: the similarity of local market conditions to foreign market conditions, domestic demand that is sensitive to the problems and needs of foreign countries, and local agents that put pressure on companies to develop exportable products. In the first place, innovations are easier to export if the environment and market conditions of foreign countries are similar to those of the domestic market the innovation was designed for. Dekimpe et al. (1998b) support the hypothesis already suggested by Vernon (1979) that the higher the similarity of cultural, social and economic factors between two countries, the greater the likelihood that an innovation design adopted by one of two countries will be adopted by the other country as well. A country is more likely to resort to a foreign design if the loss of benefit is small. Thus, the design most likely to become globally accepted is the one with specifics which are not very different from all other national demand specifics, i.e. the one which lies in the middle of the variety of national demand specifics, or with a minimal sum of differences from other countries' demand preferences. That gives a country whose innovation-specific attributes of the environment lie in the middle of the variety of environmental conditions an export advantage over countries with somewhat more extreme environmental conditions. With innovations that can be used in different environments, a company can catch up with foreign companies' innovations in their home countries at an early stage of the international competition between nation-specific technologies. International economies of scale and economies of adoption derived from international usability allow the company with "dual-use" innovations to gain an advantage over companies focussed on their home markets.

Even if the domestic environment is not at the front of a global trend, domestic users can be more sensitive to global problems and needs than potential adopters in countries where the problem is more advanced. This sensitivity of demand can push domestic companies into a global perspective and increase its ability to meet global problems before companies in other countries. For instance, consumers in one country can be sensitive to the effects of worldwide climatic change even if their domestic environment is not affected as much as that of other countries. Other examples are wildlife protection, wood cutting in the tropics and pollution of raw material extraction.

Pressure for export can come from local users, suppliers, financial sources and other national institutions. Some customers put pressure on producers to develop globally successful and not idiosyncratic solutions if they can expect lower prices for an innovation that can be exported, even if the idiosyncratic version would technically suit their own environment better. The argument of export orientation is similar to what Ohmae (1995) calls a port of entry: a region state that is shaped by the demands of the global economy and characterised by large export shares. A strong export orientation of local companies shapes the political, social and cultural system of a nation, the education of its engineers and managers, export competence of employment and its supporting institutions (governmental agencies). Export orientation can lead to the internationalisation of domestic companies via direct investment, which enhances the knowledge of domestic companies on foreign markets and increases the capability to transfer innovation designs abroad. Export oriented regions are also centres of a communications network between several large economies because firms that serve foreign markets "develop a high-level intelligence gathering capability in order to identify world trends in output, demand, market potential and scientific and technological constraints" (Walsh 1988, p. 53). The latter reverses the former argument - that other countries would subsequently adapt to the local demand preferences - and understands the lead market as a regional information centre of a global market's preferences.

Export advantages are expected to be an important advantage for small countries. The larger the country, the lower the pressure to include foreign preferences. However, Japan is an example of the opposite. Japan

introduced the catalytic converter for automobiles in the 1970s because they expected the USA to do so as well. The capacity of Japanese home video recorders was adapted to the specific length of US sport events.

3.2.5 Market structure advantages

Competition between domestic companies and low market entry barriers for new companies increases the likelihood of the local market to identify unrevealed preferences and a valuable innovation design that appeals globally because of its technical superiority, practicability or superior cost-benefit relation. First of all, industrial customers tend to be more demanding towards their suppliers when they face competition than when they are tightly regulated or hold a monopoly (Porter 1990). The number of independent buyers, together with an early saturation of a market, creates pressure for a reduction of prices and an improvement in product performance, thus giving buyers an incentive to replace an old product with the new version. Competition pushes costs down and makes a technology more price competitive against other innovation designs and the established technologies. For instance, intense competition amongst Japanese companies caused the cost of fax machines to reduce thirty-fold from 1980 to 1992 (Coopersmith 1993).

Second, competition facilitates a market's anticipatory capacity. Fierce competition between local companies reveals information about buyers' needs earlier then less competitive markets. If preferences do not vary internationally, competitive markets are more likely to discover globally latent needs and select globally successful products that meet those needs best. Competitive markets are able to generate information about a buyer's needs because more alternatives can be tested and experience can be collected on a variety of product types. Even if preferences vary internationally, a competitive market can determine the globally dominant design because it might find a more superior design compared to non-competitive markets that takes international differences into consideration. In a competitive market, a company can turn any technological advantage into a market share taken from less creative rivals (Metcalfe 1995, p. 488). Because new products and technologies are frequently brought about by new companies (see e.g. Audretsch 1995), the absence of barriers to entry (Baumol, Panzar, Willig 1982) is essential for lead

markets. The openness for new companies to enter the market makes the process more efficient in finding the design most profitable for the user by means of search and selection.

Lead markets are therefore assumed to have a high degree of competition. Empirical evidence however is still more anecdotal. In the case of Japan, however, Sakakibara and Porter (2001) find that fierce competition within the Japanese market marks the international success of innovations for which Japan is a lead market, such as fax machines, robots and cameras, whereas governmental intervention and cartels are significantly associated with Japanese industries that are internationally less competitive.

3.2.6 Discussion

It is suggested here that the pattern of the international diffusion of innovation can be explained by specific attributes of countries that increase the ability of a locally preferred innovation design to become the globally dominant design. These attributes were classified into a system of five national lead market advantages. Lead market advantages are part of a nation's competitive advantage. In fact, they can be interpreted as a refinement of the demand advantage in the Porter diamond of national competitive advantage. The five factors that constitute a lead market are interrelated. Most of the relationships between the factors are mutually reinforcing. In practice, this means that not one but rather a mixture of interdependent lead market factors determines the lead market role of a country. For instance, the market structure advantage supports the price advantage because it drives down prices. The market structure advantage facilitates the export advantage because fierce competition in the home market lowers profit margins and allows local companies to look for more profitable (lag) markets abroad.

In the next section, a case study on the cellular mobile telephone industry is analysed using the model of the five lead market advantages. It is intended to further assess the applicability of the system of lead market factors derived in this chapter. The following section will address the question of how multinational companies can use the lead market concept to increase the potential of their innovations to become global innovation designs.

4. A Case of Lead Markets: Mobile Telephony

The case has been prepared as an in-depth study that includes a broad review of existing literature, data analysis and interviews with experts involved in the development of mobile telephony throughout the 1980s and 1990s.[2] The purpose of the case study is to assess the lead market model for real world examples. The case study examines whether countries that led the adoption of a global innovation design have a significantly higher level of the lead market advantages identified above. The study shows that the global success of the European cellular mobile standard is indeed accompanied by the derived lead market advantages of those countries that led the adoption of mobile telephony.

Mobile telephony is defined as radio communication between a land station and mobile phones within a specific regional zone. The first mobile telephony systems that were employed from the 1950s were "pre-cellular" services. Cellular systems have been used since the 1980s. The difference between cellular and pre-cellular mobile telephony is that in a cellular system a user can move from one zone to another during a call without needing to reinitiate the call. Cellular telephony has a large variety of possible technical specifications. Each of cell size, modulation, coding, required power level, bit rate, quality, error code and multiplexing have to be selected from a variety of possible modes. There are several trade-offs between speech quality and amount of investment as well as cost of service, frequency efficiency, capacity in rural and densely populated areas, size of terminals (phones) and data transmission capacity. There is no unique "best" standard; the benefit of a cellular system varies from country to country depending on user demands, geography, vegetation and population density. As a result, countries selected different systems and a variety of incompatible systems were employed. At the end of the 1990s, a globally dominant design emerged within this variety: digital cellular telephony prevailed against other mobile systems and among the several standards, the European standard, GSM, dominates internationally. This worldwide success implies that the disadvantage of international standardisation must have been compensated by standardisation advantages.

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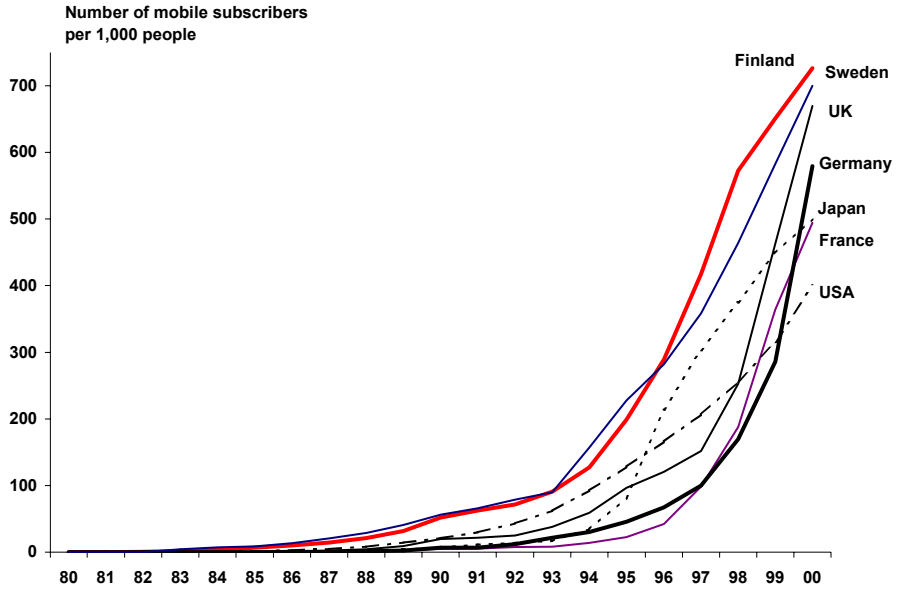
[2] For a more detailed description of the case, see Beise (2001).

The next question is whether there are countries that favoured cellular telephony and GSM early and facilitated the international diffusion of that particular mode of mobile communication and of that standard. The global success of cellular mobile telephony has the typical characteristics of a lead market model. The pattern of the international diffusion of cellular mobile telephony between 1980 and 1998 shows that several countries, in this case the Nordic countries, have a continuing lead in its adoption (Figure 3). During the whole period the penetration rates of cellular telephony were continually highest in Sweden and Finland. Although mobile cellular communication was invented in principle in the 1940s and realised in the 1970s by Bell Laboratories in the United States, a system that built on this pioneering work, the Nordic mobile telephone standard (NMT), was widely used in Nordic countries from the 1980s. In other European countries, Japan and the United States mobile telephony was regarded as only a small market niche needed and being appreciated by a small segment, such as businessmen.

Figure 3: Diffusion of cellular telephony in several countries 1980-2000

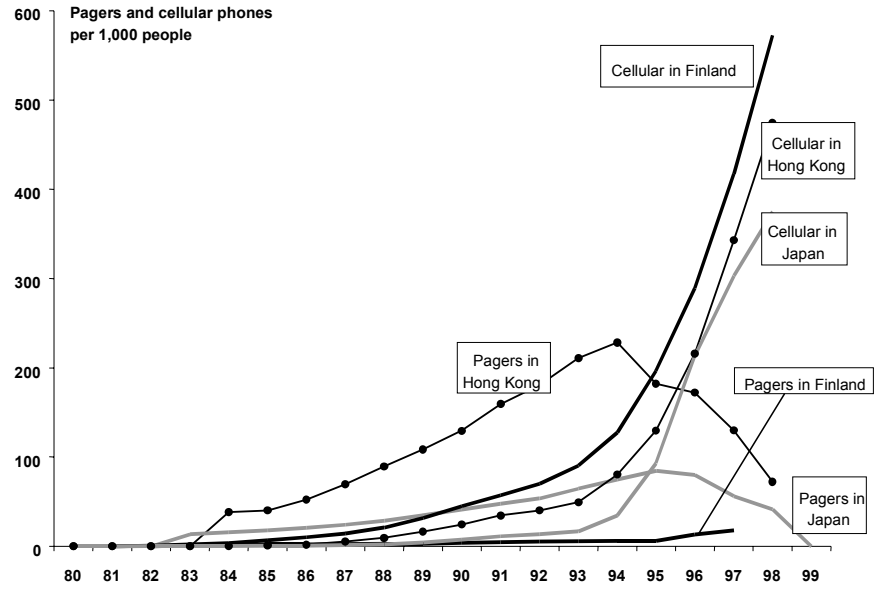


Source: ITU

Cellular mobile telephony has prevailed on the world market against other technologies of mobile telephony such as satellites, cordless telephones and pagers, which competed against cellular telephony. In contrast to the commercially successful mobile cellular telephony, these other systems of personal mobile communications either failed in the market, or have been successful in only a few countries and were

rejected by the market in most other countries. While cellular telephony generated high profits, these other services were often financial losses, even fiascos. One example is pagers, which are passive receivers of messages. Pager services were initially successful in the United States, Singapore and Hong Kong, and to a lesser extent in other countries, but a failure in some European countries. When cellular telephony emerged, the penetration rate of pagers declined in most countries. Since digital cellular telephony offers the same functionality as pagers, most subscribers to pagers switched to cellular in the 1990s.

Figure 4: Number of subscribers to pager and cellular services in Finland, Hong Kong and Japan 1980-1999



Source: ITU

Figure 4 depicts the penetration rates of pagers and cellular in Hong Kong, Finland and Japan from 1980 onwards. When the penetration rates of cellular services took off, those of pagers declined rapidly. In Finland, where more people than anywhere else in the early 1980s adopted cellular telephony, pagers were never widely adopted. Finland showed an early preference for a technology that later prevailed worldwide. Other countries, notably the Asian city-states and Japan, followed a technology adoption path that they later abandoned in order to switch to a different one. Similar patterns can be observed in public cordless and personal satellite telephony, the former favoured in Japan, the latter in the United States. Both were

finally squeezed out of the markets that initially preferred them to cellular telephony. The vast demand in Nordic countries pushed forward a new European standard (GSM), which was designed to fit the special European environment. After the GSM service was introduced into other European countries, the demand in those places grew at an unexpectedly rapid rate as well, and GSM became a worldwide success story. Consequently, two companies with headquarters in Nordic countries, Ericsson of Sweden and Nokia of Finland, dominate the mobile cellular telephony equipment market, the first one in infrastructure, and the second in handphones.

The mobile telephone industry has attracted many researchers since it became successful internationally. There are two strands of literature. First, there are econometric estimations of diffusion models (Ihde 1996, Dekimpe et al. 1998a, Frank 1992, Gruber, Verboven 1999). These formal diffusion studies were enabled (or induced) by the availability of time series data on the number of subscribers for almost all countries published by the International Telecommunication Union (ITU). They focus on the diffusion pattern of mobile phones within countries, while the lag between the diffusion in countries was not explained and the different cellular standards not taken into account. The second strand of literature contains case studies on the success factors of cellular telephony and the GSM standard in particular (Cattaneo 1994, Mölleryd 1997, Calhoun 1988, Paetsch 1993). The shortcoming of these studies is that the theoretical model is not clear. Furthermore, most studies are limited to the mobile telephony industry in one country. Applying the full eclectic model discussed above, the lead market role of the Nordic countries in the mobile telephone industry becomes more economically founded.

4.1 The price advantage of the Nordic countries

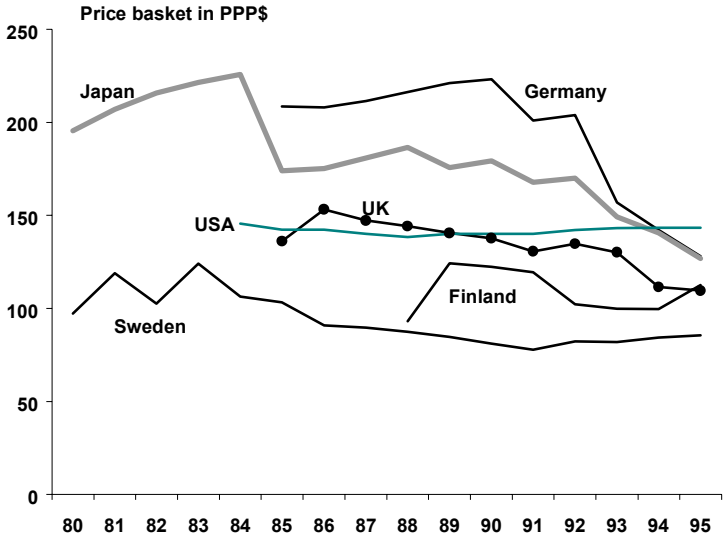
Anticipatory prices and large relative price reductions of cellular technology were the most important mechanisms that helped to spread cellular mobile telephony worldwide and to squeeze out other competing designs. As rates of penetration vary between countries so do prices for making calls. The variation of penetration rates of mobile telephony can indeed be explained to a large extent (more than

50 %) by the variation of prices of mobile calls from country to country.[3] From as early as the 1980s, the lowest prices were offered in the Nordic countries (Figure 5). Charges started at much higher levels in the other countries and decreased in the early 1990s when digital technology and competition were introduced into mobile telephony (ITU 1999, p. 73). The decrease of the total operating costs of using a handphone was supported by additional features such as calling-party-pays, handphone subsidies and alphanumeric message exchange, which made mobile telephony accessible for new segments of the consumer market: the downward trend of call charges in most countries in the 1990s means that the Nordic countries had anticipatory prices in the 1980s, constituting a lead market through price advantage. Digital cellular technology offered the largest price reduction potential compared to other designs and therefore increased its market share constantly.[4]

[3] The total price of a mobile telephone for a subscriber is a mixture of connections fees, monthly fees, call charges at peak-hour and at non-peak-hours, and the cost of the mobile phone. The OECD (1997, p. 129) published a price basket of mobile telephone tariffs that correlates highly with the penetration rate per country. Ihde (1998) and Frank (1992) also find a strong positive effect of prices on penetration.

[4] The appropriate indicator within the lead market concept would be the relative price of cellular service relative to alternative mobile services. However, data for rival mobile services is no longer available. Most of the service providers contacted did not keep records on former prices. However, anecdotal evidence says that prices of pager services, satellite telephony and cellular services of other standards were initially cheaper than GSM but did not offer the same price reductions because they did not reach the same mass-market size of the European standard.

Figure 5: Monthly mobile call charges[1] in Germany, Finland[2], Sweden, the UK and the US 1980-1995



[1] The price basket includes the monthly charge and 200 minutes of call charges.
[2] No data available for Finland before 1988.
Source: OECD, Sweden: Hultén, Mölleryd (1995), Germany: RegB, USA: Paetsch (1993), Finland: Ministry of Telecommunication Finland, Japan: Telecommunications Carrier Association, UK: Valetti, Cave (1998), own estimates.

Although the Nordic countries are not large, they operated the biggest mobile networks during the 1980s due to the low price of mobile calls and the shared Nordic mobile telephone standard. Experience and marketing activities revealed that there was a mass market for mobile telephony. Nordic telecommunication companies therefore fiercely promoted the digital system as a mass-market technology, while network operators in other countries still aimed at a more exclusive market segment. The emergence of a mass market offered large cost advantages and rapid growth of the market size paving the way for the international success of the European digital standard as a mass-market technology suitable for almost all countries worldwide.

4.2 Demand advantage

Genuine anticipatory demand needs a global trend as a transfer mechanism so that needs will automatically emerge in other markets after a certain time. Although a large benefit of an innovation in one country leads to early adoption, the country has no real demand advantage if the same benefit does not emerge in other countries as well. For instance, it has been argued that the large demand for

communication in the Nordic countries results from the low population density in these countries (ITU 1999, Echikson 1994). This only explains why Nordic countries prefer mobile telephony but not why other countries would follow. The same is true of the fax machine, which was preferred in Japan because of the pictorial characters of Chinese letters, kanji, used in Japanese.

While global trends are responsible for the internationalisation of a number of global innovations, a demand trend is not necessary for the international success of innovations since there are other possible internationalisation mechanisms. Indeed, it is not clear whether a trend, and if so what trend, drove mobile telephony to its tremendous success in the 1990s.

4.3 Transfer advantages

Three transfer advantages of the successful mobile telephony standards can be observed: (1) the maturity of a standard reduces the risk of adoption for other countries, (2) the internationalisation of demand for a specific mobile service (roaming) and (3) degree of property of a standard. A mobile telephone network is a complex system. Large networks are not easy to manage and require extensive test driving and learning-by-doing to be reliable and available under extremely demanding conditions. At the same time, a mobile system requires large investments. Reliability is one of the main competitive advantages of a mobile standard. GSM had a head start against the US and the Japanese digital mobile systems. While the GSM service was already commercially available in 1992 and GSM accepted by a rapidly growing subscriber base, the US-standard TDMA was deployed rather quietly amid suspicions regarding its technical inferiority and because of the dual-use phase in the US (Buhrmann 1997), and CDMA, another standard developed in the US, was not available commercially until 1996. The success of the GSM networks in Europe was highly visible in other countries, too. Telecom operators in these countries then realised the huge market potential in their own countries as well and adopted GSM.

The second transfer advantage of the GSM standard is its international roaming ability, i.e. the ability to make and receive calls in other countries that adopted the GSM standard. Because international roaming causes so many technical challenges, no US or Japanese standard offered an easy-to-use international

roaming capability like GSM. For the European telecom operators, roaming within Europe was important because the experience with the analogue system used in Nordic countries (NMT) which was the first to facilitate international roaming in the 1980s, showed that the demand for international roaming of users travelling within Europe was strong. GSM follows the tradition of NMT. International roaming facilitated the transfer of a specific demand for GSM services abroad. In the case of mobile telephony, businessmen and later tourists from European countries attracted telecom operators in several countries with lower per-capita incomes (e.g. Turkey) to choose the GSM standard because these customers were willing to pay more than the domestic subscribers. International roaming has a global network effect as well: as more countries adopt GSM, the benefits for users in all other countries increase as they can use their mobile phones in all countries that offer GSM services.

The third transfer advantage of GSM is its non-proprietary status. GSM is less proprietary than other standards. This could have played a role in the decision of non-European countries to adopt GSM as opposed to the proprietary US and Japanese standards. Non-proprietary standards ensured that several telecommunications equipment producers would offer GSM equipment competitively. Operators would not have to rely on a single supplier. It became common within GSM services for network operators to procure their infrastructure from two manufacturers. Since GSM is not only an air interface standard but also specifies all interconnections between base stations and network systems, smaller companies could participate in the GSM components market (Paetsch 1993, p. 287).

4.4 Export advantage of Nordic companies

In the case of mobile telephony three export advantages of the Nordic countries can be identified that facilitated the success of GSM: (1) the traditional export orientation of the Nordic countries, (2) an average population density in rural areas, and (3) the multinational environment in Europe. First of all, the Nordic countries have a traditionally export-oriented industry. Since those domestic markets are rather small, exports are necessary in industries requiring larger R&D and capital investments. For instance, Ericsson developed a digital telecommunication switch for the world market instead of a total match with

the preferences of the local telecom operators in Sweden (Bartlett, Goshal 1989, p. 25, Pehrsson 1996, p. 104). Other domestic institutions supported the export orientation of domestic companies. In the 1970s the Swedish telecom operator was convinced that a cellular mobile system had to be exported in order to justify the R&D investments required. The other Nordic countries were won over for a joint standard (Hultén, Mölleryd 1995, p. 4). In addition, the Nordic operators developed the NMT system in cooperation with Saudi Arabia and Spain who adopted the standard together with Sweden in 1981 (Mölleryd 1997, p. 32). Institutions in Sweden supported exporting activity as well. The additional export effort led to 29 nations adopting the NMT system mainly in Western and Eastern Europe, but also the Middle East, Asia (Malaysia, Thailand) and Africa (Morocco, Tunisia). Manufacturers in larger countries such as the United States, Germany and Japan were pressed to meet idiosyncratic requirements of local telecom operators restraining export activities (e.g. for Japan see Fransman 1995, p. 76).

Second, the Nordic countries have an average environment that induced innovation designs in mobile telephony that are easily adapted to other environments. The cell size depends on the environmental context as well as the population density, the density of buildings and so on (Paetsch 1993, pp. 80-82). Therefore, the environmental context determines a particular system specification that is perfect for this environment. The Nordic countries have a population density that lies between the extremes of conditions in the United States and densely populated Japan. The NMT and GSM cellular systems preferred by these 'average' countries could be more easily adapted to other environments than the system developed for the extreme environments in Japan and the US.

The GSM standard had an additional export advantage compared to the US and Japanese standards. The joint development of a pan-European standard led to the inclusion of a variety of features that different countries required due to their preferences. The GSM standard therefore became a multi-environment standard. Although this led to nerve-breaking discussions in the standardisation committees, GSM became an amalgamation of the best features.

4.5 Market structure advantage

Competition played a vital role in the success of mobile cellular systems. An international comparison shows that the introduction of competition can partly explain the variations in the penetration rates. Among previous studies, only Gruber and Verboven (1999) included an indicator for competition in their diffusion estimation. They found a significantly positive but small effect of the introduction competition (mostly duopolies) in digital mobile communication service on the speed of diffusion in the 1990s. Although cellular telephony was introduced in Japan first in 1979, it was operated under a monopoly until 1988. Sweden was the first country where two competitors offered mobile telephone service. In 1981 a private company, Comvic, was allowed to operate a mobile service. Though Comvic remained a small mobile operator compared to Telecom Sweden, its marketing activities were strong and innovative (Mölleryd 1997). In Finland, competition existed between the mobile operator and the regional fixed-line operators as early as 1982. The other European countries granted licenses to private operators only in the 1990s when the digital systems became available and after the EU commission recommended competition (Paetsch 1993). As early as the start of the 1980s, the US regulator's aim was to implement a competitive environment in the cellular service. However, the process of license assignment delayed a competitive market in the cellular industry and caused call charges to remain higher than in Sweden during the 1980s (Calhoun 1988).

The introduction of competition created lead market effects: (1) it drove prices of calls and phones down from the time of market entry; (2) through entrepreneurial effort, new services and applications for mobile telephony were discovered; (3) competing companies promoted cellular services through marketing activities and attracted new consumer segments, and (4) competition enabled the mass-market suitability of cellular telephony through lower prices albeit for a lower quality.

5. Lead Markets as a Source of Global Innovation Designs

For multinational companies knowledge about lead markets for their respective products can be important strategic information in industries in which standardisation forces are potentially large enough to

overcome differences in preferences from country to country. In those industries, in which lead markets are likely to emerge, they can be used as a source of global innovations designs. Lead markets are not only a chance for the development of global innovations. They are not only important for international companies but also for companies that are only active in a regional market, because lead market designs can squeeze out other locally successful innovations. The assessment of the likelihood and identification of lead markets is therefore a vital part of every company's innovation strategy.

The lead market hypothesis suggests that countries can be endowed with product-specific attributes that increase the probability that an innovation design that finds the affection of users in the local market becomes an international success as well. This means that a company can leverage a regional market to increase the chance of global market success of standardised innovations. Learning about what the users in the lead market prefer strengthens the ability of a multinational company to develop global innovations. Johansson and Roehl (1994) propose that foreign companies can learn in lead markets and build the competitive capabilities, "invisible assets" in their vocabulary, with which follower markets can be attacked. If the preferences in the lead market can be identified through market research, a company can then focus its innovation development on these regional preferences. If preferences are difficult to access or there is a variety of preferences with no clear regional preference, lead markets can be used as a test market. Even when companies hardly know *what* innovation design or technology will prevail on the world market, they will probably have a better idea as to *where* this selection is going to take place. And this regional focus can be a competitive advantage as well because companies that concentrate their attention on lead market dynamics recognise chances and threats of the global market at a much earlier stage. In this sense, a lead market is a forecasting laboratory for companies for a specific product function or user need. For instance, companies in the Nordic countries were first to realise the importance of elegant and fancy designs of mobile phones and personal ringing tones. One reason for this forecasting capacity of a lead market is the nation-specific attributes of the lead market role described above, the other

simply results from the highest penetration rates in the lead market. The lead market is the first market where new market segments use the product revealing their segment-specific preferences.

Learning in the lead market requires at least strategic market research in the lead market. Bartlett and Ghoshal (1990) suggest that multinational companies can take advantage of lead markets by locating market and technological "sensing resources" in them, using their output as input in the innovation process. A further step is to locate innovation development resources in lead markets in order to respond mainly to the local market environment. Local R&D activities in the lead market take full advantage of close user-producer interaction from the perception of market demand to the development of innovations and during the launch phase. To locate resources in the lead market is more efficient than just monitoring the lead markets because domestic companies, including affiliates of multinational companies, are more likely to sense and respond to local innovation opportunities than companies located abroad. Scholars and practitioners alike such as Lundvall (1988) have stressed the preferred perception of demand preferences and user feedback by local companies since Linder (1961) formulated his home-market thesis.

For a company willing to develop global innovations this local bias towards the domestic environment was often a disadvantage. In the case of lead markets, the local bias of R&D units towards local conditions can be an advantage if the affiliate in the lead market is given the responsibility for the development of innovations that best suit the lead market and that would later be leveraged to become global innovations. If lead markets are present or likely in the range of products the company is engaged in, the location selection for R&D can be based upon the maximisation of the lead effect of countries. That means, R&D assignments for particular innovation projects are to be concentrated in the respective lead markets. Following the demand of the lead market avoids both over-customisation and investing in innovations to suit regionally idiosyncratic needs. The development of innovations of a multinational company with a globally dispersed R&D network allocated by lead markets will concentrate on user needs or environments that are able to impose their design on all other customers and leave idiosyncratic customers to adapt to the standard or increase expenditure for customisation.

The lead market strategy aims at globally standardised innovations through responding to specific local markets. It requires an organisation that is able to respond to the local conditions of a foreign country and at the same time is committed to globally standardised innovations. The problem is that companies that follow a local responsiveness approach often have no organisational means of introducing a globally standardised product to the world market while companies following a standardisation approach do not have sufficient resources in their foreign affiliates to respond to the local innovation opportunities. Aware of the possible success of locally leveraged innovations of foreign subsidiaries and the efficiency of global innovations, Bartlett and Ghoshal (1990) envisage the transnational corporation that has the flexibility, the means and the commitment to transfer local innovations within the global organisation and make the other affiliates conscious of the benefits of lead market innovations.

Lead markets do not exist for all products or processes. The likelihood of the existence of lead markets depends on the degree of variety of market conditions. It can be expected that likelihood and variety have an inverted u-shaped relationship. If the stimuli of adoption were the same from country to country, designs would not be favoured in different regions and one would expect a globally interspersed pattern of adoption of innovations; no regional market would actually lead the international adoption of an innovation. If the stimuli for adopting an innovation vary internationally, countries prefer different innovation designs. The internationalisation mechanisms described above can compensate for the different adoption preferences. But if countries vary so much that standardisation advantages are unlikely to compensate for these differences, lead markets cannot occur. Instead, there would be the persistent adoption of region-specific innovation designs.

Yet lead markets can even exist in industries that are characterised by regionally fragmented markets. For example, despite the efforts of big auto producers to come up with a “world car” in the mid-range sedan, such as the Ford Mondeo, a persistent reluctance to abandon nation-specific requirements frustrates standardisation efforts I the car industry. On the other hand, internationally successful specialised cars such as very luxurious cars, sports cars or SUVs emerged from specific regional market demand. They are

globally successful despite the fact that their value is especially high in a particular driving context. This means the probability of lead markets must be assessed and lead markets identified.

6. Concluding Remarks

To summarise, the lead market concept of generating global innovation design is based on the assumptions that (1) innovation opportunities are regionally dispersed since initial market conditions and demand preferences are region-specific, (2) that location-specific demand and needs can be perceived more efficiently by domestic companies and their local R&D units in order to develop innovations that best accommodate them and, (3) that particular characteristics of local demand increase the probability that local innovations can also be commercialised on the world market. The third hypothesis represents the core meaning of lead markets.

If the existence of a lead market is possible, knowledge on which market is going to take the lead in the world market will be highly important for a company participating in that market, preferably with its own R&D activities and in close collaboration with local customers in that market. Lead markets are not only an opportunity for multinational companies they are also a threat. Companies that do not participate in lead markets risk being committed to idiosyncratic demand and locked in to a technology, a standard or a design which is well received in the local environment, but will not succeed in other markets. Even in high-tech industries, technical progress is not solely driven by scientific advance but also by local markets. If markets are different, it does not suffice for multinational companies to concentrate R&D in the region with the highest scientific excellence. A company must be aware of lead markets as well. The lead market concept suggests that there are host environments that support the international success of a locally preferred innovation.

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