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Assessment of Sectoral Innovation Systems Approach: the Case of Turkish Internet Service Market

Abstract

The aim of this paper is to evaluate sectoral innovation system of Turkish internet service market by looking into some case studies and making interviews with related actors. In this attempt, firstly, a sectoral innovation systems approach has been described briefly from theoretical point of view. Then, third section introduces sectoral innovation systems of internet services. At fourth section, two case studies are mentioned. At the following chapter, we focus on regulatory developments that affect market and sectoral innovation systems regarding broadband internet access in Turkey. Fourthly, we describe the results of interviews done with executive officers of several large Internet Service Providers and a general secretary of a sector association in this country. Finally, we discuss the policy implications for Turkish policy makers in order to improve the functioning of sectoral innovation systems of internet services. At the conclusion section, we summarize the main findings and policy suggestions.

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Keywords: competition, innovation, internet service market, sectoral innovation system, telecommunications, regulation.

1. Introduction

In the last decade, rise of the Internet has been changed the entire structure of telecommunications sector. According to OECD (2009), the Internet has grown from 30 million hosts in 1998 to 540 million hosts in 2008 and we servers have grown in number from 2 million in 1998 to 33 million by mid-2008 so that these serves help enable more than 175 million websites to form the World Wide Web. In time, communications and hence internet services becomes more important for economic growth since they provide basic services for the whole national economy. In the long term, productivity is the key determinant to sustainable economic growth. To boost productivity by encouraging technological change, national innovations systems policies are developed. They constitute basis for both creating/entering new markets with new products that embodied more value added and decreasing unit costs. However, setting right policies to support economic growth via this way, one should know how an existing economy functions from innovation perspective. In this paper, we will attempt to reveal sectoral innovation system for internet services sector for Turkey. This attempt, for our knowledge, is the first study on sectoral innovation system for internet services sector in Turkey. Therefore, we hope that this paper will give a good starting point for further studies. The scope of the paper is limited with internet services although we mention about telecommunications in general.

The organization of the paper is as follows. At the next section a sectoral innovation systems approach has described briefly from theoretical point of view. Third section introduces sectoral innovation systems of internet services. At fourth section, two case studies have mentioned. At the following chapter, first of all Turk Telecommunications sector has discussed briefly, then the history of internet services in Turkey has described. Thirdly, we focus on regulatory developments that affect market and sectoral innovation systems regarding broadband internet access. Fourthly, we describe the results of interviews done with executive officers of several large Internet Service Providers at Turkey and a general secretary of a sector association. Finally, we discuss the policy implications for Turkish policy makers in order to improve the functioning of sectoral innovation systems of internet services. At the conclusion section, we summarize the main findings and policy suggestions.

2. Sectoral Innovation Systems (SIS)

The innovation system approach considers innovation as a collective and an interactive process between various actors. For the innovation system approach, learning is the key determinant of innovation. National innovation system, regional innovation system and sectoral innovation system are different approaches among the innovation system approach. Sectoral innovation approach has mainly proposed by Malerba (2002). He (2001, 2002, and 2005) defines a sectoral system of innovation and production is a set of new and established products for specific uses and the set of agents carrying out market and non-market interactions for the creation, production and sale of these products. The main building blocks of a sectoral innovation system are defined by Malerba (2005) as knowledge and technology; actors and networks; institutions. According to Malerba and Mani (2009), firms are key actors in innovation and production in a sectoral innovation system. They have specific learning processes, capabilities and organizational structures,

expectations and goals. Other actors may be suppliers, users, universities, financial institutions, government agencies, trade unions or technical associations. Networks refer to the market and non-market relationships between firms (other actors as well) within any sectoral system. In uncertain and changing environment formal as well as informal networks emerge because agents are different and so networks integrate complementarities in knowledge, capabilities and specialization. These relationships are a source of innovation. Instead of an aggregate set of similar buyers, demand is seen as composed of heterogeneous agents who interact in various ways with producers. Institutions include norms, routines, common habits, established practices, rules, laws, standards and so on. Knowledge does not diffuse automatically among firms. Firms have to absorb knowledge through differential abilities accumulated over time.

The theoretical basis for sectoral innovation system depends on different traditions and approaches. Malerba (2002, 2007) explains that there are studies on change and transformation of sectors like industry life cycle literature and studies of Schumpeter, Kuznetz and Clark; studies on links and interdependencies and sectoral boundaries; innovation system approach and finally evolutionary theory. Evolutionary theory provides analytical measures. In this framework, there is a special emphasis on process of transformation of the sector. In other words, historical perspective or path dependence is important to understand a sectoral innovation system. Agents have bounded rationality, thus they are incapable of optimal decisions. Finally economic change can be explained by the concepts variety creation in technology, products, firms and organizations, replication which generates continuity in the system and selection which reduces variety in the system and discourages the inefficient uses of resources. Furthermore, evolutionary perspective implies that there is no an equilibrium interaction and environment and conditions are very different. Links, sectoral interdependencies and sectoral boundaries are very important within sectoral innovation system. The interdependencies and links among related sectors are captured within the boundaries of sectors and those boundaries or links may change over time. Furthermore, dynamic complementarities among activities and artefacts are a potential source of innovation. The vertical links in production may provide an incentive to geographical concentration for different sectors in a particular area. Dynamism in the system is created through these complementarities and links.

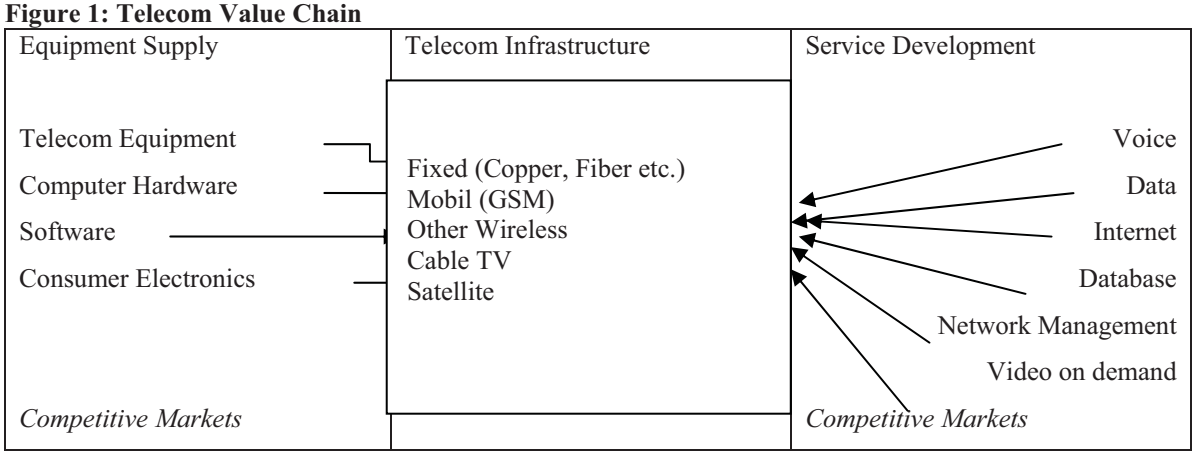
3. Sectoral Innovation Systems (SIS) of Internet Services

As mentioned before, understanding of the components and working of the system is crucial for the efficient implementation (and outcomes) of any SIS. So as a starting point (for this specific sector), a figure related to telecommunications sector is given to indicate subsectors and relations between them.As it is shown in figure-1[1] telecommunications sector is composed of many subsectors and both service based and production based submarkets can be identified in this macro sector. As Malerba indicates this sector can be divided in many sub sectors and different technology regimes and trajectories also exist in the same sector. In fact if we take into account current developments due to very rapid changes in information and communications technology (ICT) and convergence phenomenon, the picture even gets more complicated. This is also a good example for Malerba's argument that sectoral boundaries are not fixed and over time elements and their interactions in SIS are subject to change continuously. Before going into details of

[1] Of course, this figure is not a very detailed one and many other items can be included in both three categories.

convergence, it is worth mentioning the relations between these three segments sketched in the above figure. In this context, Melody (1997) asserts that main driving forces for change[2] in the sector have come from equipment supply side and secondly from innovations adopted and marketed by value added service suppliers. However, here, it should be stressed that –as in any evolutionary approach- there is no uniform rule to rank the innovative (in a sense pull sector) segment of the market. Indeed, Malerba (2005, p.389) indicates the fact that *the features and sources of knowledge affect the rate and direction of technological change,* leading to different (dynamic) roles to each actor and sub segments in the related sector. For instance, virtually every related actor ranging from public authorities to business firms have actively involved in the development of GSM technology in Europe.

Figure 1: Telecom Value Chain



Apart from the interactions between these sub segments, the role of demand in dynamism of telecom SIS should be also not neglected. As stressed in Porter's so called diamond model (1990), existence of sophisticated buyers (i.e. demand) lead to both product and process innovations to satisfy these needs, also increasing competitive advantage of these countries' firms. To give an example, it is sufficient to observe the Apple's success in this field (e.g. iphone coupled with many applications) shows the crucial role of stimulating (satisfying) consumer needs (requirements). Of course, this phenomenal success should be analysed within a macro perspective, and other factors such as establishment of Microsoft, public support and role of universities in the development of internet have all played role in both direct and indirect ways.

[2] Change in boundaries and type of relations between actors and even between institutions and actors.

Above all these considerations, starting from 1990's, thanks to convergence, *a technological development eliminating the boundaries between the computer/consumer electronics, telecom and media/publishing industry*, telecom sector is continuously moving from a relatively simple structure with a fixed chain of production to a more complex and changing chain of production (Skouby, 1997). Indeed, convergence, nowadays, lead to another fundamental shift in the sector; 'triple- play'. What triple play means is that, due to this technology, operators (now) are able to offer TV, telephony and internet via cable (TV) and/or fixed telephony network. Due to this development, Janssen et. al., (2008) state the fact that not only new competitors are coming to the market but also (and this is the most important part) two former monopolists (i.e. cable and fixed telecom networks) are entering into each other's domain. In fact, this development brings new (in a sense radical) challenges to both firms and policy makers (regulators) in the market. As an example, it is stated in the various parts of the 15th Progress report of EU that, there is not a uniform regulatory approach to this development and exist a lively debate between the market actors to find an optimal regulatory approach.

Knowledge and learning processes: According to Nelson et al (1982), there exists three dimensions of knowledge that differs between sectors; accessibility, opportunity and cumulativeness. In telecommunications sector, it can be said that each of these dimensions have influenced the development of related markets. To start with, both equipment and infrastructure markets exhibit high degree of cumulativeness and opportunity conditions. For this reason, many countries (such as Korea) have designed national programs to develop their domestic capabilities (of their firms) in these sectors to get competitive advantage over other countries. For example, EU, USA[3] and China (one can also add Korea) have all developed their own [4] 3G standards to compete in the international markets and promoted both equipment producers and infrastructure providers to this end. Of course, once the disruptive effects of a new technology (Utterback, 1994) ends, then other factors such as learning curves, first comer advantages, economies of scale and other barriers to entry become decisive for the more mature market structure. As it will be shown in the following part, both in fixed and mobile telecom markets, Turkey has not faced with such experience (e.g. adoption of new or emerging technology) due to her technology follower status and in both markets the latter mentioned factors such as scale economies become crucial factors for the outcome (i.e. market structure and competitive level). However, the service development part may resemble to software sector in that both accessibility is high and start up costs are relatively less than the other two market segments. For instance call centres, GSM application developments (programs, utilities etc.) and internet content provision are all relatively easy to establish, but success (outcome) will also depend on country specific factors such as abundance of well educated and English speaking, at the same time low paid, work force of India behind the establishment of international call centres in this country.

Agents: Agents and institutions should be defined in any sectoral system along with the place of this system in the bigger picture (i.e. National Innovation System- NIS). Indeed, this sector, taking into account all the sub sectors is so important that (again in line with Malerba's reasoning) these actors - in essence - come to be part of any country's NIS. For

[3] Though some differences exist between these two, since EU deliberately promoted one technology, namely GSM, whereas this was not the case in USA.

[4] A centralized and top down policy in a sense but at the same time collaborative effort of all related actors.

the agent and institutions part, there exist so many (as the above figure indicates) that, one should make a very detailed analysis before stating every element that directly or indirectly take part in the system. Firms play the most important role in any SIS. As argued by Malerba (2001) these business entities also encompass users and suppliers who have different types of roles and relationships with other firms. For instance whereas in the past (i.e. monopoly period in USA) both telecom equipment and service producers were the same, as technological change and resulting competition in service markets increased, these two were separated and began to operate in different markets. In the current market conditions, telecom equipment producers and service providers (especially those who owned physical infrastructure) have involved in continuous relations to upgrade and even develop new technologies, with the addition of public agencies to support this process (e.g. development of GSM standard in EU). In this sense, it can be said that there exists a close link between producers of telecom equipment, service providers and other related actors. Indeed, one can argue that the more interactive and close these relationships, the better for the overall performance of the sector by adopting Porter's line of reasoning. Within this context, lastly, it should also be mentioned that like in any SIS, firm heterogeneity in telecom sector should be emphasized and policy prescriptions should be differentiated to the specific needs of these different undertakings (e.g. fixed vs. mobile service providers, telecom software vs. application developers etc.). In addition to this, as the above table shows, this sector encompass many different actors both active in sectoral and national level. Some of them even operate internationally and their actions directly affect the market development process (e.g. as mentioned above ETSI's role in GSM standard development and resulting competitive advantage of Europe vs. USA in this area).

Institutions: As argued in the first part; institutions are composed of laws, norms, routines, habits, traditions, standards, regulations, to name a few of them. In essence, all social constructs that modify (influence and shape in a sense) actions of agents and the way the interactions are made between these undertakings can be seen as institutions. Of course, some of them are more important or binding (e.g. laws, regulations etc.) than others (e.g. norms, practices etc.). Even, in the binding category, one can find different attitudes of agents towards laws or regulations when different credibility issues exist occurring from capacity constraints of public agencies. Secondly, some institutions are established for only telecommunications sector, whereas others are related with all sectors of nation's economy.

Having seen main points of telecom SIS, it may be appropriate to sum up basic features before passing to detailed case studies. Firstly, it is clear that convergence has (and continue to) deeply influenced sectoral dynamics. In this context, it can be said that wide variety of different specialized and integrated actors involved in innovation, ranging from the large telecom equipment producers to the new telecom service firms is due to the process of convergence of previously separated sectors like media, telecom and ICT related applications. Moreover, as seen in European Telecommunications Standardization Institute's (ETSI) role, innovation is very much affected by the institutional setting, regulation and international standards. Related with this, the knowledge base of the sector is also changing and expanding such as wireless internet receivers, two way communication capabilities over cable TV platforms etc. Besides this, these developments also lead to emergence of wide variety of actors, which were previously in different sectors, each one stressing different set of competencies (e.g. internet service providers, content providers e-commerce companies etc.). To further complicate things, due to

continuous developments in ICT, co-evolution of the structure and capabilities (also varieties) of actors are changing in a more rapid pace day by day. We, each day, now see the emergence of new applications like speech recognition, natural language processing and tele-health methods using audio visual technologies thanks to new broadband platforms (especially fiber optics). In the last place, the role of regulatory authorities (e.g. standardization, privatization, tariff regulation etc.) and demand (e.g. user producer interaction) have also continue to influence the developments in the sector.

4. Case Studies

4.1 The Fixed Internet SIS

There are limited studies on sectoral systems of innovation for telecommunications. A unique attempt is made by Edquist (2004). Edquist has conducted a study on internet and mobile telephony or 'new' parts of the telecommunications sectoral innovation system. He aims to understand the dynamics of transformation and convergence in those fields. He includes both equipment production and the production of intangible service products since they are complementary in the sense that service innovations are dependent upon manufacturing innovations and vice versa. In this framework equipment production includes routers, exchanges, base stations, handsets…etc. Internet services mean provision of access to the internet and contents at internet provided by internet content providers. Edquist wants to reveal the knowledge base of the sectoral innovation systems of data communications and mobile telecommunications, their organizations and institutions and the boundaries of the sectoral systems. Obviously, the main function of an innovation system is carrying out innovations. However, the functions of the sectoral innovation system include activities leading up to innovations. Edquist outlines some of the most important functions in the fixed internet and mobile telecommunications as development of equipment, R&D relevant to the further development of the system, provision of relevant education and training, creation of standards and other regulations of importance to the system, provision of access, development of new content, provision of consulting services.

As discussed in the previous part, these functions are performed by organizations or agents, actors or players. According to Edquist and Johnson (1997) organizations were formal structures with an explicit purpose, which were consciously created. For instance, equipment developer firms such as Siemens, Ericsson, Cisco and Motorola are organizations. Edquist and Johnson (1997) have defined the institutions as sets of common habits, routines, established practices, rules or laws that regulate the relations and interactions between individuals, groups and organizations. For example, laws concerning deregulation and liberalization, technical standards, access tariffs, intellectual property rights are institutions. Institutions are formed and changed by actions of organizations. After Edquist has constructed the basis described above, he has started to discuss the relations between institutions, organizations and functions. According to him, the basic transformation which has made possible to develop a new sector was the digitalization of fixed networks. The appearance of packet switching technologies and the Internet Protocol were the main breakthroughs to achieve that. Packet switching technology optimizes the use of bandwidth by dividing any kind of information such as voice, data and video into packets which are sent from one network node to another without sequentially. In other words, at the initial stage information is divided into packets that follow different paths in the network until to their target node. Then at the receiver node these packets are integrated

again. At the traditional circuit switching network, in order to start and keep the communications there must be established physical path or link. Therefore, technological innovations at well established telecommunications sector has caused to born a new sector or sub sector. Packet switching technologies were developed with public technology procurement process. In other words, a public agency placed a contract to a firm ordering to development of a technology or artifact that did not exist at the time of granting the contract, but which the partners believed could be developed. In this case, the US Defense Advanced Research Projects Agency (DARPA) granted a contract to some engineering firms in Cambridge, Massachusetts to built packet switch, which was called ARPANET. Later, two engineers worked at this project have developed TCP (Transmission Control Protocol) which allows physically distinct networks to interconnect with one another and then they have published the specification in 1974. This protocol has split up two pieces and called TCP/IP (Transmission Control Protocol / Internet Protocol) later. Today, it has become the technical definition for Internet.

Edquist explains the reasons for dominance and rapid diffusion of TCP/IP by public organizations' choices and the need for standardization of newly emerged computer industry. Apart from reliability and being open standard there was an emerging computer industry such that they had began to standardize on a common platform, Unix operating system. As a result, it became the dominant protocol for most networking applications in the early 1990s. Another milestone has been passed when National Science Foundation in USA have adopted TCP/IP as standard on its national university system. NSF and DARPA founded a set of organizations to regulate the standardization of the backbone of TCP/IP in 1970s (Edquist).The Internet Configuration Control Board (ICCB) was later renamed as Internet Activity Board (IAB). It has two sub groups: the Internet Engineering Task Force and the Internet Research Task Force. The interesting thing is that there is no any international organization like International Telecommunications Union (ITU) with country membership. Those institutions have not formal power. IAB is the main organization in the development of Internet standards and telecommunications operators and manufacturing firms are very influential on it. USA firms such as Cisco, IBM, DEC, Sun are very competitive at world scale in the production of equipment sector due to early diffusion of internet technology and associated emergence of large domestic market with emergence of highly competitive complementary sectors like computer software firms.

The sectoral boundaries at telecommunications and its related sectors are rapidly changing. Edquist underlies the convergence fact as a reason to explain this transformation. In other words, there is a convergence between various parts of telecommunications, between information technologies and telecommunications and between information communications technology and the broadcasting/audio-visual technologies. For instance, internet access technologies and mobile communications technologies are converging into 3G. Likewise, fixed telecommunications infrastructure becomes next generation networks or networks based on broadband internet technologies. Another immediate effect of this process is that knowledge base for the telecommunications sector becomes more complex and diverse. To sum up, Edquist concludes three policy implications. First, it is evident that institutions including standardization and deregulation have played very important roles in the development of this sector. Secondly, the relations between different organizations and between institutions and organizations are crucial for the functioning and performance of sectoral systems of innovations. Public technology procurement has played vital role to the

emergence of Internet. Finally, it is especially important that public policy intervention occurs early in the development of the sectoral system.

4.2. Korea's internet service and equipment SIS

Korea is among the leading countries in terms of broadband internet penetration and speed available to users. In fact, according to OECD (2009) statistics, this country ranks fifth in broadband penetration category. However, if one look into technology platforms, it can be said that Korea has one of the most developed (i.e. fiber optic) infrastructure in terms of availability, along with Japan. There are a lot of studies to explain this success. For instance, in several ITU reports (2001, 2003), geographic conditions, population density, government support and direction, strategy and continuous commitment of relevant actors, market competition, and demand side factors -among others- are shown as the most important factors for this outcome. In this respect, Youngbae et al. (2008) argue that these studies have stressed individual factors (for this success), ignoring one fundamental issue; interactions between all the related actors in a sectoral innovation system. Accordingly, it is emphasized that to understand the evolution of Korean internet market, one has to analyze the role and interactions of various actors in an historical context, since development and commercialization of broadband internet service has the characteristics of an innovation system where cooperation and coordination of various actors ranging from internet service providers, equipment providers, content providers and government agencies are crucial for the well functioning of the system.

The Korean government has initiated the first attempts by preparing an action plan named 'Cyber Korea 21' in 1997. With this plan, Korean government (Ministry of Information and Communication, MIC) aimed to achieve information society objectives such as access to broadband internet by every citizen. What is more important is that, all the related actors' cooperation and coordination by the government has been emphasized for the success of this action plan. The first problem in the market evolution process was the selection of appropriate technology. In telecommunication markets, this is either done by market forces and/or by government policies and selection. In fact, both market actors and policy makers actively participated in the selection and development phase of GSM technology. This decision (along with some others such as licencing policy) may be considered as one of the most important phase due to lock in and sunk cost considerations[5]. Within this context, Youngbae et al. (2008) indicate that, government agencies selected the appropriate technology - ADSL - after detailed investigation and extensive discussions among themselves (e.g. MIC, ETRI and KISDI). After this selection, uncertainty related to technology was resolved and policy makers concentrated on market (demand) uncertainty. In that period, there was only one Internet Service Provider (ISP) using fixed network of the country (Korean Telekom). To increase market competition, another ISP, Hanora Telecom, was founded to give ADSL service in the market. This company also formed a partnership with one of the leading equipment producers (Alcatel) of this time. Connected to this development and seeing the need for some domestic capability in equipment production segment, MIC began to provide subsidies and R&D funds to these firms along with service providers to deploy their infrastructures. On the other hand, MIC also initiated meetings and consultations with content providers and ISS firms in the subject of pricing issues. Korea's success can be found in the initial market development stage and policy coordination of government was the primary factor in this

[5] One can also add many others, including resulting market structure and preference of competition etc.

outcome. Another important development in this era, was the (starting of) provision of cable modem services by competitive firm, Thrunet. Indeed, introduction of broadband services by alternative platform operator increased other firms' efforts to develop their infrastructures as a result of matching strategies (not to lose market share). This is also important for Turkey's case in that one platform were given priority at the expense of another, resulting in low competition and penetration levels.[6,7]

Hence, in the early stages of market growth, a competitive environment with three operators (incumbent, new ADSL operator and cable platform operator) has been created to the benefit of consumers. In addition to this, it can be seen that MIC also supported these operators to lower their tariffs (to increase demand) in the form of preferential loans. Indeed, to increase the growth rate of demand further, MIC started to give certain certificates to buildings with broadband internet connection and initiated a consortium to provide low cost computers to the people (Kim et al, 2008). Connected to this, content sector has also achieved increasing growth rates and various software programs and applications ranging from e-commerce to online gaming, video on demand services (to name a few). In this stage, it can be said that (due to lower economies of scale and need for capital) increasing number of start-up firms in this segment further accelerated demand for faster and more reliable (always on) platforms like fiber optics. For the equipment side, it is seen that firstly Daewoo electronics entered in the market with the cooperation of Alcatel. Then Hyundai established commercial relationship with the incumbent (KT) related to ADSL equipment. Lastly, Samsung Electronics and subsequently local manufacturers began their production in this field. However, as Kim et al (2008) indicates with the market liberalization and pressure from mainly China (and Taiwan) based firms, domestic providers failed to upgrade themselves and performed badly as opposed to successful service and content segments of the market.

In essence, though Korean example may be said to an inapplicable case to other countries, one can take several general policy lessons irrespective of country specific conditions. First of all, as in other developed countries (even USA, in terms of internet market development), government initiative and policy coordination can be regarded as the most important role in the market development process, because of market specific characteristics (i.e. sunk costs, first comer advantages and network externalities). Related to this, demand side stimulation in the form of PC subsidies etc. has also been very important since this type of actions both helped the sector and the people who could not afford these equipments, reducing digital divide at the same time. Thirdly, and in line with SIS approach, government agencies role in building and sustaining relations (interactions) between every related actor should be taken as a prerequisite for any project to increase the probability of success. This, of course, necessitates a capable organization both in terms of planning and controlling abilities. Fourthly, even the relative failure of equipment segment shows that government planning and support may not be adequate for success and firms have to select most suitable entry positions depending on their current capabilities and continuously upgrade themselves in every dimension as suggested by Porter to stay competitive in the global market.

5. SIS of Turkey's Internet Service Market

[6] More detailed discussion is made in Turkey's SIS case study part.

[7] Of course, one can add many other factors for this outcome; e.g. weak regulatory environment, delaying tactics of the incumbent, selection of privatization model etc.

Turk Telekom finalized the construction of internet backbone called TTNet in 2000 and began to provide (after offering preliminary technology, ISDN) ADSL broadband services in the second half of 2003. Other ISPs also wanted to provide ADSL by making use of this unique backbone and continuous interactions and conflicts between these actors have been occurred ever since. In this respect, public agencies (especially ICTA and CA) have frequently intervened by regulations (institutions) to regulate (behaviour) of all undertakings in the market. Currently there exist 108 ISP that are permitted by ICTA to operate in the related sector[8] and the number of subscribers (of ADSL services) has been increased from approximately 60 thousand to 6.2 million at the end of 2009.

This number reaches to approximately 6.8 million or 9% penetration rate if we add other technologies like Cable TV and 3G. However, Turkey remains in one of the last places among OECD countries in terms of penetration rates[9].

Table 1: The Number of Broadband Internet Subscribers with respect to Alternative Technologies

Technology	ADSL	Cable	ISDN	Satellite	3G	Grand Total
# of subscribers	6.216.028	146.622	16.570	7074	396.363	6.782.657

Source: ICTA (2010).

As it is seen from Table 1, ADSL subscribers occupy % 97.3 of total internet subscribers of the country. In fact, this figure shows one of the most important problems of Turkey's internet service market both in terms of competition and innovation; there is only one network platform and no competitive threat (to force any innovation) exists in the market. For instance, whereas Cable TV internet penetration is approximately % 6.6 in Europe, this figure barely reaches % 0.01 in Turkey.

As shown in Korea example, competition between different platforms is very important for increasing operators' efforts to innovate (i.e. new and cheaper services). This competition also forces these firms to expand their coverage by constructing new infrastructure (or upgrade them) to meet unsatisfied demand. In Turkey, there also exist two fixed networks for the use of broadband internet providers. However, as already discussed, the alternative platform (Cable TV) has not been used satisfactorily to create a competitive concern for the incumbent in fixed telecom network as practiced in many other countries (other than Korea) such as USA and Canada. Regulatory authorities (in Turkey) have also intervened in this network to increase inter platform competition since 2001. It is no doubt that limited role of this platform (not even one percent of total number of subscribers using this network) and continuing monopoly situation (i.e. only Turksat is the active provider) should be some concern for public agencies and related actors in the market. Taking into consideration the fact that, Turksat is –in the first place- concerned with satellite related work and services, one can also question the effectiveness of marketing capability and objectives of this company. Moreover, as a public operator, Turksat operates under budgetary constraints to upgrade and/or extend the coverage of this platform, exacerbating the problem further. With these problems and in the light of current conditions, it is clear that there is no easy solution for these problems and above all considerations, first of all a clear vision and realistic policy measures should be designed with the inclusion (and active

[8] http://www.tk.gov.tr/doc/lisans/ISS_bildirim_giris.htm
[9] OECD average penetration rate is app. % 22.8 at the end of 2009.

participation) of all related actors. Detailed discussion of these are beyond the scope of this paper, but at this stage, establishment of another company (solely responsible for Cable TV) and creation of a consortium of firms, that want to use this platform, to make necessary upgrades to the network may be suggested as discussion topics in these interactive meetings. There is no information related to use of (and market share) fibre optic technology in this country in OECD statistics. Nowadays, countries that want to upgrade their networks to next generation networks have increasingly focused on the construction of fibre optic technologies. Indeed, the use of this technology in terms of penetration rates has reached to % 15 in Korea, % 12 in Japan and OECD average becomes % 2.1 at the end of 2009. It is known that some ISPs and Turk Telekom have started to construct fibre networks, but information about the extent and coverage does not exist publicly. Apart from these two traditional networks, as a result of technological developments, wireless and fibre technologies have increasingly been used in internet service markets. Especially, fibre optic based networks are considered a prerequisite for next generation networks that enable very high speed upload and download capability for the users. For this reason, all the nations that have well developed internet service sector are currently concentrating on expanding their fibre optic network coverage by devising various policies such as giving tax incentives, preferential loans to business firms. In Turkey also, as opposed to already established fixed network, fibre deployments have been started by Turk Telekom and few other ISPs. The exact figures is not publicly available but it is known that in metropolitan areas such as Istanbul, this kind of investments will be increased in parallel with increasing demand for higher capacity from both residential and business customers. However, taking into account the fact that much more investment levels are needed to reach meaningful coverage rates and this is an expensive process, some kind of policy coordination is also required in this category. At this level, it can be said that new investments may be exempted from regulatory intervention for a certain period to give incentives to ISPs. Secondly, given the deficiency of private investment levels, various projects funded by public finance should be pursued in selected regions where investment conditions are not favourable. Within this context, universal service funds can be used and more importantly open access method should be used in such projects. This kind of projects is starting to be used widely in various EU countries such as Italy and Netherlands. For instance, alternative ISPs in Italy formed an alliance to construct open access fibre network under the policy coordination of regulatory authority of Italy[10]. Similarly, but not identical, Municipalities in Netherlands undertake city wide (e.g. Amsterdam) fibre networks where many ISPs can operate and give value added services to customers (Sadowski et al. 2009). Such kind of projects and actions are clearly needed in Turkey and for these to be planned and put into action (similar to Cable TV but even more important for transition to next generation networks), related actors should develop new action plans (to continue e-action plan) beyond 2010 and this time by adding more emphasis on inclusion, accountability, cost and benefit analysis and assessment of performance (of responsible actors). Apart from this, there is another problem in the fixed network resulting in low competitiveness; the incumbent operator's market share in the ADSL is above ninety percent (% 91), implying the market power of this undertaking. In fact, this ratio is the highest among the European countries. For instance, the highest ratio in EU belongs to Cyprus (Greek part) with 81 and Luxembourg with 71 percents, while EU average is between 40 to 50 percent (EU Commission, 2009). It is evident that broadband internet forms one of the most important infrastructures of knowledge economy and lead to various transformations in both social and economic aspects. In this respect, in order to

[10] Cullen International EU regulatory reports, available at www.cullen.int

sustain their competitive advantages, countries aim to increase broadband internet use (access) of both their people and institutions. Connected to this, virtually every country is devising and implementing various policies to achieve this objective. Hence, as (seen) in Korea and other countries action plans (e.g. e-Europe action plan), Turkey has also prepared and put into action various plans and programs to develop her information infrastructure along with ICT usage throughout the country. To start with, in the 9th development plan (2007-2013) the general aim is to increase broadband subscriber penetration ratio to %20 and internet user penetration rate to %60 at the end of 2013. In the light of this macro plan, Turkish State Planning Organization (SPO) has also prepared 'Information Society Strategy and Action Plan' to put forward detailed policies to achieve global level information society targets. This plan is composed of seven main strategic priorities[11] and corresponding action plans are stated in each main priority. Related to this, responsible agencies have been determined in each policy section. In this regard, it is clear that this plan is required coordination and continuous monitoring to increase probability of attaining its targets. What is more important is that, as anyone familiar with the politics and public administration in this country know easily that without monitoring and evaluation, any program may easily be forgotten or not pursued satisfactorily to attain its objectives. For this reason, looking into this action plan and implementation phase, one can easily said that although the plan itself has been well prepared (and detailed), there exists problems due to above mentioned issue. Although all these (seven) strategies are related to the internet service sectoral innovation system of the country in terms of both supply and demand side aspects, detailed discussion of each is beyond the scope of this paper. Of course, to make an analogy to Porter's diamond model again, all parts of the system should support each other, if growth and innovative capacity want to be achieved. In other words, if there will not be enough demand for internet services (both access and content provision), then internet service providers also do not make necessary investments to increase coverage and at the same time reduce prices. This will in turn -like a vicious circle- further increase demand for these services. However, this process should not be taken as granted and in reality every government has devised policy packages to support these processes[12]. For instance, provision of low cost computers to certain segments of society (e.g. students and teachers) stimulate demand for both equipment, access and content (e.g. education material in native language) but this clearly necessitates a role for government agencies to implement various policy packages ranging from subsidies, use of universal service funds and preferential loans to tax reductions. In addition to this, similar to above discussion, to increase demand, public services has also been increasingly given from internet platforms (e.g. e-government). With these general considerations in mind, it may be useful only to discuss issues related with widespread and affordable telecommunications infrastructure and services, since these are of crucial importance for the efficient functioning of (broadband) internet service market and system of innovation.

Table 2: Action Plan Related to Widespread and Affordable Telecommunications Infrastructure and Services

A- Creating a competitive environment

[11] Namely, Social transformation, ICT adoption by businesses, Citizen focused service transformation, Modernization of public administration, Globally competitive IT sector, competitive, Widespread and affordable telecommunications infrastructure and services, Improvement of R&D and innovation.

[12] One also should not forget the importance of digital divide problem and role of social policies in this regard.

Policies	Agencies (responsible and related)	Target achievement**
Establishment of competition in services	Inf. and Com. Tech. Aut. (ICTA)- (responsible) Ministry of Transport (MT) Competition Authority(CA)	Unsatisfactory
Establishment of competition in infrastructure	ICTA (responsible) MT CA	Not achieved
Feasibility study for wholesale and retail services of the incumbent	ICTA (responsible) MT CA	Unknown for the writers
B- Developing and expanding communication infrastructure		
Promotion of shared next generation telecom infrastructure	ICTA (responsible) MT CA	Unsatisfactory
Aggregated public broadband procurement	MT (responsible) SPO Public procurement agency (PPA) Turksat	Unknown for the writers
Aggregated public broadband procurement	Radio and Television Supreme Council (RTUK)- (responsible) Min. of defence MT ICTA TRT	Unknown for the writers

* Not discussed in detail. /**Writers evaluation

Above mentioned policies are stated in the plan aimed to achieve three main objectives; to increase competitive level of the sector among EU countries (1-5), to increase coverage rate of broadband internet (from %75 to 95) and to reduce the cost of access in terms of the ratio of cost to GNP per capita (from %5,4 to %2). In this context, it can be said that second objective is easy to achieve, since this does not mean much from an efficiency point of view. That is to say, the important thing is to (first) increase penetration rate and (second) increase the use and adoption of these services by individuals, public agencies and business firms. However, what is clear is that, the first objective has not been achieved at all. Indeed, in terms of last ECTA scores (the same score taken in the action plan also) Turkey has not achieved considerable success and remains in one of the least successful among EU countries with reference to competitive performance. Secondly, regarding specific policy objectives, without going into much detail, one of the most important problems may be stated as the lack of coordination, interaction between actors and public knowledge (discussion). Simply, there is not enough knowledge about these policies, e.g. current situation, problems etc. For this reason, it can be stated that, if the performance of internet service sector is to be increased and any new action plans (post 2010) will be made, this time continuous public involvement and monitoring by a dedicated agency (perhaps a new one to create some level of synergy) with more powerful institutions (but at the same time) necessitates more transparent and open to discussion environment.

5.1. Interactions between actors and institutions

We have conducted interviews with some important ISPs' executives in order to reveal the real working and features of sectoral innovation system for internet services in Turkey. In fact, interviews have been made with various ISPs[13] in the internet service sector to evaluate market characteristics, extent of actors' interactions, power relations and value chain features by face to face, by telephone and by e-mail[14]. The information obtained from interviews is illuminating at least. In general, ISPs in Turkey are very young firms. Indeed, a sector of providing internet access and related services is a very young sector of 15 years age at most. Most of them have limited financial capacities, a member of group firms or very small business. The scale of these firms is understood to have employees ranging from 5 to nearly 1000 in one or two cases. Otherwise, it can be said that (sectoral) average is between 100 and 150. These firms are predominantly established by Turkish citizens and in only few cases there exists some foreign based companies that own some share of these undertakings.

According to firms' views, there are two large groups in Turkish telecommunications market, namely Turk Telekom group and Turkcell group with large financial capital to be invested and with extensive technical capabilities. They are the main actors as firms in internet services sector as well. Turk Telekom has absolute control on TTNet, the obvious dominant firm in the Turkish market. Turkcell has bought Tellcom (Superonline) and with its financial backing, Tellcom is the only firm that is building a large infrastructure other than Turk Telekom[15]. The other firms in the market simply have not adequate financial capital to compete with them at national scale with owning large infrastructure. In addition to this, these service providers (without much exception) are located in Istanbul (especially in Gayrettepe), highlighting the importance of this metropolitan area for the sector. According to respondents, excluding TTNet, five important ISPs are; Koçnet, Doğan, Superonline, Milenicom and Turknet. Only a few of them are considering building their infrastructures in limited and certain regions (e.g. Istanbul region) and even in this case all of them remain dependent on TTs network. Business customers are the main priority for these firms and it appears that intense competition exists to keep or gain new customers in this segment. Apart from this, all ISPs state that competition (with TTNet) does not exist at all and complain about the behaviour and operations of the incumbent. In these complaints, one of the most important (given emphasis) is the delaying tactics of the incumbent in various categories. For example, the respondents allege that it takes too long to complete any contractual agreement with the sole network provider.ISPs mostly get other licences such as Mobile Virtual Network Operator (MVNO), satellite operations but most of them are concentrating on internet service providing and to some extent giving voice services. However, since there is no significant costs having more licenses, firms are simply holding some licenses without actual service provision in order to seek future business opportunities. It appears that ISPs do not have much difficulty in getting qualified personnel. In the first place, these firms get needed technical and experienced personnel from other ISPs. For other kind of work that is not required such experience, university graduates are preferred for various reasons, e.g. lower wage etc. From the available data,

[13] Five ISP executives and one from sectoral association are contacted. The positive returns, however, are more limited. Indeed, we may interview three ISP executives and a sectoral association comprehensively. To expand the research scale we need more time. However, we believe that we may still deduce main systematic features of sectoral innovation system for internet services in Turkey more or less.

[14] The questionnaire is prepared in Turkish, since it is quite long, some questions are skipped depending on interviewers' available time.

[15] Tellcom invested an amount of 500 million TL last year to build infrastructure. However, its investment is geographically limited with the ring of İstanbul, Ankara and İzmir. From profitability point, it is a rational decision.

there is no much evidence for the preference of 'working at home' instead of working in the office. But, in the medium term, it appears that (from the interviewers' point of view) the ratio of personnel working at home is going to increase in relative terms. The high turnover ratio between firms in the sector may imply that there is a high information flow between those firms as well. These firms have been established associations to exchange information and make some lobbying activities to protect their interests. It appears that there are a few of such agencies but some of them are represented by other firms that operate in other sub segments of telecommunications markets (e.g. GSM). One of the leading association (Telkoder)'s functions is given as sharing of market information and new technologies, giving information about regulations and legal advices. In fact, some small ISPs are completely depending on Telkoder for some legal and regulatory issues. Telkoder has also a trust building function at the sector. In other words, Telkoder seems organizing formal and informal meetings or some social events for members. Therefore, it facilitates to form bilateral social relations and to build trust between executives and key employees. In this regard, respondents also emphasize the role of this agency to create a social environment to exchange knowledge and share new business opportunities. For instance, as a result of such interactions, a peering agreement with six ISPs are made and in some circumstances these firms engage in some kind of cooperative investment projects. In other words, in these meetings one operator states its investment plans and give some capacity to another in exchange for other capacity in a different region, where counterpart firm has some infrastructure. Without such social trust base, it is impossible to cooperate described above since they are essentially rival firms at highly competitive market. Interestingly, TTNet is not a member of Telkoder. In fact, all the other ISPs that are members of Telkoder have a common motivation to compete with TTNet. Besides this, it appears that ISPs are making use of consulting firms, but this is mostly regarding legal affairs and no considerable technical advice is required by these firms. There also exist continuous relations between market actors and regulatory authorities. ICTA seems more frequently contacted regulatory agency with respect to CA. However, the decisions of these two organizations are decisive on the market structure and hence sectoral innovation system. Without licences many new services cannot be supplied to the market even the firms were ready to provide. The interactions take various forms and most important ones are giving opinions to the regulations (feedback) and making complaints about the alleged anti competitive practices of the incumbent operator. Within this context, it may be concluded that (under existing data) ISPs are generally satisfied with the relationship between regulatory authority in the process of regulation preparation phase but complain that in the implementation phase, TT is favoured in several cases due to this company's lobbying power and influence capacity. The Ministry of Transportation is also vital organization, whose decisions affect the market and the sector both directly and indirectly since some equity shares of Turk Telekom still owned by government and the Ministry has a decisive power on election of ICTA Board members. The Ministry of Transportation has also formal power to decide the national policy for the whole telecommunications sector. In practise, however, owning conflicting interests may create problems and the sector is well aware of this fact. In this perspective, full privatization of Turk Telekom maybe better policy for the future of sector. Lastly, this survey could not give any detailed assessment for the relationship between equipment providers and ISPs in the market. It appears that there is not a dominant equipment provider due to the increasing role of software in the operations of these firms. However, like in many other markets, in Turkey also there exist a few important equipment providers like Cisco, Huawei and Acatel among others. Moreover, the study could not find a considerable level of R&D activities made in ISPs,

although some level of process innovations (e.g. giving new value added services etc.) are observed during these interviews. In general, firms have not adequate financial capital and human resources to allocate direct R&D effort except TTNet and maybe Tellcom. However, they are innovative in the sense that they follow the world closely and they bring the new services and new technology to Turkey as much as possible. Therefore, they are technology followers from world market point. Some interviewed firms have also owned partly by foreign telecommunications firms and there is a direct linkage between main foreign firm and the Turkish cousin for technology transfer and education. In addition to these, firms follow each other very closely in the market and they are quick to copy with each other for new services. Indeed, one respondent has told us that even copying at some time was beneficial since the market has expanded. The other important stimulus is the customer demands. The main driver for introducing new services is to increase market share, keeping it and creating new markets. We think that there are four primary activities, namely wholesale service procurement, marketing and sales and service support in the value chain for ISPs. There are also three main supportive activities that are firm infrastructure, human resource management and equipment procurement. The value chain is quite different from average industrial business. ISPs are dependent on wholesale services provided by network operators. In other words, they must buy wholesale products from incumbent. Indeed, in Turkey it usually means Turk Telekom. From operations we mean that they have to operate their basic network. It means that with or without their operational centres must be connected to internet and/or other ISPs. Marketing and sales activity is the next activity at the value change. ISPs will increase or decrease their capacity with respect to the final demand from end users. Therefore, at value creation process marketing and sales activity is very important. Finally, they have to monitor the services and make maintenance when necessary. From the main supportive activities, firm infrastructure includes organizational structure, management control systems ...etc. Activity of Human Resource Management is straight forward. Activity of Equipment Procurement contains the purchase of necessary network and monitoring equipment. Since required equipments are produced by various firms, prices of equipment are relatively similar[16]. In conclusion, a further study is needed since our study is limited with several firms in the sector due to limited time. Especially, further research should be focused on TTNet and Tellcom as well as other relatively important firms. TTNet has some innovative product such as Vitamin and it has also some innovative firms like Argela and its operations are not limited with domestic market. Likewise, Turkcell group must be studied to expand this research.

6. Policy Implications

Having evaluated Turkey's internet service SIS, the first thing that can be said is that it is necessary to study the relations and the ways to improve them, to increase the innovative capability of all related actors. Within this process, benchmarking of the sector performance in various issues (e.g. anything ranging from infrastructure capacity to software, equipment development capacity, penetration rates) should be done to both assess the current situation and set new targets in a predetermined time period (e.g. a five year strategic action plan). Since, SIS approach necessitates active participation of various agents; any undertaking or plan should aim at bringing as many actors as possible leading to establish long lasting relationships between them. With this broad aim in mind, policy

[16] However, if there is a very large buyer, then substantial cost reduction may be possible for buyer.

makers should target both broadband and mobile technologies sub sector in the country. As it is clear from the above discussion, the role of regulation is crucial for the performance of this sector. In this regard, relations between private and public organizations in the form of research funding, standard setting or public procurement can increase the performance of SIS. In addition to getting ideas of each actor, establishment of a new institution or parallel one like the case of Baden- Wüttemberg to be responsible for the implementation of such projects may be beneficial to get some dynamism and at the same time avoid (decrease the possibility of) lock in situations. Secondly, again after making industry wide surveys and meetings to discuss analysis outcomes, priority ranking of projects should be selected to stay under budget limits (under the assumption that every organization and/or project has a budget limit) and to increase the probability of success. Thirdly, to enhance R&D efforts, the interactions between research institutions and business firms should be emphasized by giving proper incentives such as in the form of subsidies, tax reliefs, provision of suitable space etc. In this process, firstly industry level association should be either established or (if it exists) its capacity should be enhanced. As it is seen in our interview results, such organizations are extremely useful for knowledge sharing and dissemination among related actors. Following this, again by using project funds and regulatory organizations leading role, universities should be attracted to take part in some specific sub level project objectives such as equipment modifications (e.g. minor modifications in some telecom equipment such as extension of the range of base stations or fiber optic technology). By this way, universities mentality or long term strategy may be influenced to create more specific courses and research oriented programs (increasing human resource quality, not in the short term but in the medium term). In the mean time, establishing science parks to give vocational training to individuals and provide help (in any kind including new technologies, organizational and legal developments etc.) to business firms may be beneficial for their competitive performance in the market. In line with the Porter's arguments that a solid domestic base is necessary for the global competition, it can be said that such continuous help and training may increase these firm's capabilities to innovate and compete in a global level. Fourthly, due to convergence, not every segment of the sector requires large scale investment and sunk cost investments, as in some segments like internet content provision or software development for GSM applications. For these segments, to create incentives, venture capital financing mechanisms (since these do not require large scale investments) can be created, also within the scope of the project (e.g. creation of a permanent support mechanism). Within this scope, it is even more important to give proper incentives to still new and developing applications in internet service markets. This point is particularly important since the use of internet and provision of content are related to different sectors (ranging from automotive to health care) and these markets have still a lot of growth potential (and also many sub segments). Fifthly, in line with the argument that regulation plays a considerable role in this sector, a practice adopted in China may be applied within this project concept (of course, this hypothetic project should be taken as a bunch of policy prescriptions and have many sub level targets). Actually, although not in the scale of China (because of her unique situation) some kind of obligation is put forward to 3G mobile operators to support SME's operating in this sector. In more specific terms, this policy necessitates an establishment of R&D center for each operator and minimum buying measures from domestic equipment providers in the establishment process of 3G network such as radio link and base station equipment. We think that each investment (new entry, license conditions) should be accompanied by such kind of policy measures to increase (or establish) supplier- buyer relationship and to some degree capability of domestic SME's. Lastly, issues related with

Cable- TV and next generation networks should be put in to public agenda to open extensive discussions about future policy actions, to avoid past mistakes that lead to (near) monopoly situations and inefficient markets.

7. Conclusion

To conclude, it can be said that although SIS approach has some weaknesses, the use of this system also brings about many positive outcomes. Most important of all, by adequate system analysis, one can see as many details as possible about the workings of the sectoral system. After this, missing links whether in the form of new organizations, institutions and/or operational capabilities (strengths and weaknesses) may be more easily identified to give policy prescriptions. But, no one can deny that other traditional economic policy methods or approaches are not useful, and on the contrary these tools should continue to be implemented in various degrees (depending on the status, development level of a sector). For instance, in telecommunications sector -in some segments like call center operations- services based on low cost labor is important and industry policy mechanism should be designed to support this, whereas in others, incentives should be changed to give more priority to infrastructure investment, development of new technology like Wimax (adopting to domestic conditions) and the establishment of domestic production capability of some software parts. It is clear that in such a process, use of traditional policy mechanisms have many roles to play to support the sector. This kind of approach may still be considered in line with evolutionary economics, since no one knows the best policy alternative and chance of success beforehand, so adopting a well balanced policy mix –at least- may increase the probability of attaining sector's objectives, provided that all these phases are implemented in an open environment (everyone should see, observe the policy implementation, i.e. establishment of transparency and accountability) and some kind of policy evaluation mechanism is established to assess cost and benefits of these actions. In this study, although in a limited scale, some of the problems of the sector have been highlighted by making interviews with related actors. At this stage, it can be said that more detailed analysis in this regard should be made with the inclusion of public agencies executives' opinions along with the incumbent operator's views. As a last word, it is evident that future studies related to the (reasons of) inefficient performance of the sector and possible remedies to increase both competitive and innovative level of the market will be useful for any policy action that is adopted by public agencies.

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