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"Technology spillovers among downstream firms in vertical and independent B2B e-marketplaces"

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«Θα ήθελα να αφιερώσω αυτή την εργασία στην πολυαγαπημένη μου αδερφή Ευγενία, στους γονείς μου και στην κολλητή μου φίλη Καούρη Ηλιάνα. Επίσης θα ήθελα να ευχαριστήσω όλους τους συμφοιτητές μου στο μεταπτυχιακό και κυρίως την Μπάλλιου Ναντίρε και την Αλιπράντη Μαρία για την ψυχολογική υποστήριξη σε αυτήν την προσπάθεια που κατέβαλα να φέρω σε πέρας την παρούσα εργασία. Ένα πολύ μεγάλο ευχαριστώ και στον Κουργιαντάκη Μάρκο για την πολύτιμη βοήθεια του πάνω στο αντικείμενο της παρούσας διατριβής καθώς επίσης και στους Γαλανάκη Κωνσταντίνο και Μητρόκωστα Βαγγέλη. Τέλος, ευχαριστώ θερμά τους καθηγητές μου στο master για τις γνώσεις που μου μετέδωσαν και ιδιαίτερα τον καθηγητή μου Πετράκη Μανόλη σαν επιβλέπων καθηγητή της μεταπτυχιακής διατριβής μου. Χαίρομαι πολύ που μέσω αυτού του μεταπτυχιακού προγράμματος έζησα στιγμές και απέκτησα εμπειρίες ανεκτίμητης αξίας, γνώρισα ανθρώπους αξιόλογους που θα μείνουν για πάντα στη καρδιά μου και διδάχθηκα πράγματα που με έκαναν πιο δυνατή και θα με συνοδεύουν σε όλη μου τη ζωή.»ι

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1. ABSTRACT

Undoubtedly, electronic commerce can enhance technological spillovers among firms. In this thesis, we investigate how technological spillovers affect the strategic behaviour of all participating agents (buyers, suppliers and intermediary) in a vertical B2B e-marketplace. Assuming technology spillovers among downstream firms, we first analyze the strategic decisions of both downstream and upstream firms (buyers and suppliers) transacting through an e-marketplace; then we focus on the pricing policy of the intermediary who owns the e-marketplace. Our analysis suggests that the existence of high spillovers in such electronic platforms boosts both buyers and suppliers and improves the intermediary's profits. In addition, the intermediary prefers to apply pricing policies with high membership fees and low commissions, especially in cases where the number of firms in the downstream market is low. Finally, social welfare is analyzed.

2. INTRODUCTION – MOTIVATION OF RESEARCH

Undoubtedly the emergence of Internet and of electronic commerce contributes to the widening of markets geographical limits, and hence the creation of a global market. This happens due to the fact that Internet and e-commerce are able to transform the boundaries of the firms and at the same time reduce the cost of international transactions. As a consequence, it is obvious that issues related to e-commerce start to become of a high importance.

In the "New Economy", there are two dominant electronic business models (EBM): e-shops, which are mainly related to B2C (business-to-consumer) practices, and e-marketplaces. The second ones are electronic platforms, which aggregate a large number of buyers and suppliers for the fulfillment of their transactions. They are used for B2C transactions (e.g. e-malls), or C2C transactions (e.g. eBay), or B2B transactions (e.g. RetailExchange.com). Within the framework of e-marketplaces, B2B part fairly wins the role of the leader, as according to the United Nations (UN) reports (UNCTAD, 2002-2004; 2005-2006) B2B is estimated to take the most important share, from 92% to 95% of the total e-commerce. Besides, the rapid growth and the success of B2B e-commerce is due to the significant advantages e-marketplaces offer to the participants-firms comparatively to the traditional B2B markets. So, the focus of this master thesis will be concentrated on B2B e-markets and more specifically on vertical and independent B2B e-markets. Popovic (2002) categorizes B2B e-markets on the basis of industry focus and ownership structure. With reference to the industry focus, a B2B e-market can be vertical if it is organized in order to facilitate the transactions within a specific industry sector or horizontal if it is organized in order to provide a lot of different industries sectors simultaneously with some services. As far as the ownership structure is concerned, there is a classification between independent, consortia and private B2B e-markets. The independent B2B e-markets are neutral communities of many sellers and many buyers, the consortia ones are created by a few large participants joining forces to face their market inefficiencies and the private ones are communities where one large player establishes one-to-many connections to ensure in depth integration and tight relationship with its buyers/sellers. Generally, the majority of B2B e-markets are vertical and independent created by independent firms like venture capitalists or firms of new technologies.

Furthermore it is worthwhile mentioning that B2B e-markets, specifically the vertical

and independent ones, constitute typical examples of the two-sided markets. According to Evans (2003), the two-sided markets have three main characteristics: the existence of two distinct categories of players (buyers and suppliers), the presence of positive indirect network effects (an increase in the number of firms on the one side causes an increase in the firms' profits of the other side), and the inability of the players to make these network effects endogenous without the existence of an intermediary. In other words, the owners of the independent B2B e-markets constitute a new type of intermediaries in the B2B two-sided markets. The role of the intermediary in the electronic B2B exchanges is very important, as it provides a lot of services like aggregation, trust enhancement, market facilitation and matching (Bailey and Bacos, 1997). The basic sources of an intermediary's revenues are the membership fees and the transaction fees.

One of the major questions in the two-sided markets refers to the pricing policy of the intermediary. Upon this subject, there has been a great contribution from Rochet and Tirole (2003), Evans (2003), Caillud and Jullien (2004), Yoo et. al. (2004), Armstrong (2004), Katsamakas and Bacos (2004), Jullien (2004), Nocke et. al. (2004), Bhargava and Choudhary (2004), and Sulzle (2005). All the aforementioned projects look into the way the pricing policy of an intermediary is affected by some aspects of the two-sided markets, like the ownership structure of the e-marketplace, the ability of the firms to participate in one or more transaction platforms, the power of the positive or negative network effects, the diversification of the products available in the e-market, e.t.c.. A more analytic presentation of this kind of research has been given by Kourgiantakis et.al. (2007). Kourgiantakis et.al.(2007) through a proposing model gave answers to questions like: Which is the optimal pricing policy for an intermediary who charges both sides (buyers and sellers) with membership fees and commissions[1] ? How the industry structure affects the pricing decision of the intermediary and reversely? Which can be the strategy of the intermediary in case that it has such a market power that it can choose the number of participants in the B2B e-marketplace? Among the most significant conclusions of this research is that the intermediary of a vertical B2B e-market prefers imposing pricing policies with high membership fees and low commissions, because these policies are more profitable and to manage this kind of pricing policies it is essential for the intermediary to operates a B2B market with a small number of members at least in one of the two

1 Commission is the price per unit of product exchanged and is charged by the intermediary to every participant in the independent B2B e-market. On the contrary to a big part of theoretical literature for e-commerce, which uses as a pricing instrument of an intermediary the transaction fees (price per completed transaction), Kourgiantakis (2007) introduces commissions instead of transaction fees.

sides. Also, it becomes clear that in both sides of a B2B e-market there are direct and indirect network effects that should be taken under consideration from the participants and the intermediary.

One important positive network effect is technological spillovers, which has not yet been examined in the case where an intermediary exists in a B2B e-marketplace. Technological spillovers are defined as the diffusion of a firm's confidential information, such as engineering information, demand forecasts and production schedules, to its competitors (Gartner group). Technology (or knowledge) spillovers arise when part of the knowledge generated by an organization spills over its borders and becomes available to other organizations (Nelson, 1959; Arrow, 1962). This means that they have an unintentional character and their importance for strategic decisions at the firm level is highlighted in several papers. For example Jaffe (1986) and Bernstein and Nadiri (1988) investigate the impact of spillovers on firms' productivity and performance. Also, Jaffe et. al. (1993), Teece (1986) and Saxenian (1996) showed that one of the most important determinants of the amount of technology spillovers is the density of firms' clustering in a given geographical area and as Griliches (1992) states, "spillovers are present in clusters[2] and their magnitude may be quite large". Generally, when a firm belongs to a network (e.g cluster or electronic network) it takes a great advantage of technology spillovers. Unlike to a traditional business network, in a B2B e-marketplace there is a faster and more intensive diffusion not only of explicit but also of tacit knowledge due to the great contribution of ICT on facilitating innovation, particularly since the recent emergence of the Internet, The World Wide Web, and the electronic commerce (OECD, 2000). Besides, firms that participate in a B2B e-marketplace face their goods more as a kind of knowledge (or technology) and thereby they are more familiar with innovations and investments in R&D (or new technologies), which makes technology spillovers dominant in a B2B e-market. Not to mention that technological diffusion in a B2B e-market drastically decreases a firm's unpreparedness to make electronic exchanges or electronically collaborate with other firms (Zhu et. al., 2003).

Technology spillovers are considered to be one of the biggest concerns of firms about joining a public B2B e-market (Gartner Group). Milliou and Petrakis (February 2003) show that the degree of technological spillovers among downstream firms (or

[2] There is no specific definition for cluster but we could define it as every technological concentration in a limited geographical place.

buyers or final good producers) affects the decision of a downstream firm on whether to participate in a public e-marketplace or create its own private e-marketplace (an increase in the degree of technological spillovers makes stronger the incentives of the final good producer to create its own private e-marketplace). Milliou and Petrakis identify the degree of technological spillovers with the extent to which information about the quality improvements of a downstream firm becomes available to its competitors. However, they assume that there is no intermediary in the public vertical B2B e-market. The question that logically arises is: what are the effects of technology spillovers among downstream firms in a vertical and independent public B2B e-market, where an intermediary exists? So, the objective of this master thesis is to study the effects of technological spillovers on the strategic decisions of all agents (downstream firms, upstream firms and intermediary) in a vertical public B2B e-marketplace. It is worthwhile analyzing how the degree of technological spillovers affects the strategic behavior of the firms and the pricing policy of the intermediary. Before describing methodology, which will be followed in order to come to some conclusions, the next section of the thesis encompasses some basic theoretical elements for better understanding of e-commerce and more specifically of B2B e-commerce. The following theoretical focus is based on an extensive literature about e-commerce.

3. THEORETICAL FOCUS

3.1 Generally about the e-commerce

Undoubtedly, the last decade due to the great rate of development of information and communication technology (ICT)[3], there is a considerable tendency from the traditional way of doing business to the digital one. Terms, like e-commerce and e-business, are widely known for their relation with conducting business through electronic networks. A complete definition for e-commerce is: "e-commerce is the use of electronic communications and digital information processing technology in business transactions to create, transform, and redefine relationships for value creation between or among organizations, and between organizations and individuals."[4]A second broadly used definition is: "e-commerce is a modern business methodology that addresses the needs of organizations, merchants and consumers to cut costs while improving the quality of goods and services, and increasing the speed of service delivery" (Shaw and Strader 1997). From this definition it is obvious that e-commerce offers specific efficiencies, which are primarily related to costs reductions and gaining of time. The forces fueling e- commerce can be classified in 3 categories:

I.Economic forces. One of the most evident benefits of e-commerce is economic efficiency resulting from the reduction in communications costs, low-cost technological infrastructure, speedier and more economic electronic transactions with suppliers, lower global information sharing and advertising costs, and cheaper customer service alternatives

II.Market forces. Corporations are encouraged to use e-commerce in marketing and promotion to capture international markets, both big and small. The Internet is likewise used as a medium for enhanced customer service and support. It is a lot easier for companies to provide their target consumers with more detailed product and service information using the Internet.

III.Technology forces. The development of ICT is a key factor in the growth of e-commerce. For instance, technological advances in digitizing content, compression and the promotion of open systems technology have paved the way for the

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[3] ICT (information and communications technology - or technologies) is an umbrella term that includes any communication device or application, encompassing: radio, television, cellular phones, computer and network hardware and software, satellite systems and so on, as well as the various services and applications associated with them, such as videoconferencing and distance learning.

[4]Definition adapted and expanded from Emmanuel Lallana, Rudy Quimbo, Zorayda Ruth Andam, ePrimer:An Introduction to e-Commerce (Philippines:DAI-AGILE,2000),2.

convergence of communication services into one single platform. This in turn has made communication more efficient, faster, easier, and more economical as the need to set up separate networks for telephone services, television broadcast, cable television, and Internet access is eliminated. From the standpoint of firms/businesses and consumers, having only one information provider means lower communications costs. [5]

As far as the term of e-business is concerned, we do not have to confuse it with e-commerce. While some use e-commerce and e-business interchangeably, they are distinct concepts. In e-commerce, information and communications technology (ICT) is used in inter-business or inter-organizational transactions (transactions between and among firms/organizations) and in business-to-consumer transactions (transactions between firms/organizations and individuals). In e-business, on the other hand, ICT is used to enhance one's business. It includes any process that a business organization (either a for-profit, governmental or non-profit entity) conducts over a computer-mediated network. A more comprehensive definition of e-business is: "The transformation of an organization's processes to deliver additional customer value through the application of technologies, philosophies and computing paradigm of the new economy." Three primary processes are enhanced in e-business:

I. **Production processes**, which include procurement, ordering and replenishment of stocks; processing of payments; electronic links with suppliers; and production control processes, among others;

II. **Customer-focused processes,** which include promotional and marketing efforts, selling over the Internet, processing of customers' purchase orders and payments, and customer support, among others; and

III. **Internal management processes**, which include employee services, training, internal information-sharing and recruiting. Electronic applications enhance information flow between production and sales forces to improve sales force productivity. Workgroup communications and electronic publishing of internal business information are likewise made more efficient [6]

The classification of e-commerce on the basis of the notion of region is: supra-regional, regional and local e-commerce. The supra-regional e-commerce refers to the activities of e-commerce that take place in supranational entities, like the

5 For a more extensive discussion on convergence , refer to Edwin S.Soriano,Nets,Webs and the information Infrastructure

6 Lallana ,Quimbo,Andam,4.CF.Ravi Kalakota and Andrew B.Whinston,Electronic commerce:A Manager's Guide (USA:Addison Wesley,Longman,Inc,1997)19-20

European Union (EU) and Asian region. A very good description of the global and supra-regional e-commerce is given in the United Nations reports for "E-commerce and Development" (UNCTAD, 2005, UNCTAD, 2004, UNCTAD 2003, UNCTAD, 2002). As far as the regional/local e-commerce is concerning, the regional e-commerce takes place into national boundaries or in a wider region of a country and the local e-commerce takes place in smaller areas, like towns and prefectures. Steinfield and Klein (1999) first discuss analytically the hypothesis that taking a local or regional focus can be a successful factor of e-commerce diffusion. It is worth mentioning that small and medium enterprises (SMEs) gain a competitive advantage from the adoption of local B2B e-commerce: first embeddedness in pre-existing relationships enhances consumer trust and recognition of online firms; second, integrating online business with local presence helps to serve diverse consumer preferences and shopping habits and takes advantage of local knowledge; third, such firms can take advantage of an existing infrastructure for delivering physical goods and services. However B2C practices cannot only provide local SMEs with the expected or the optimal profits but cannot also provide them with an incentive to go globally. It is local B2B e-commerce, and more precisely the collaborative one, that can give local SMEs more direct benefits and become the vehicle for their introduction to global e-commerce (Kourgiantakis, Petrakis, 2006). Collaborative B2B e-commerce is this type of B2B e-commerce with the greatest functional integration and the highest degree of innovation. According to Thuraisingham et. al. (2002), the Internet and the Web enforce knowledge management, and knowledge management promotes collaboration, instead of competition.

3.1.1 What is an electronic business model (EBM)

Without doubt going into e-business without an EBM is like going into business without e-business plan .For information technology specialists an EBM often boils down to technological solutions like a Web site, a portal or an e-business place. For visionaries and other strategy experts, the EBM becomes a reflection of the strategy to be implemented as a means of conducting e-business. For managers with financially-oriented training, it turns out to be the business plan for an e-commerce project. An EBM is much more complex since it combines and integrates all of these dimensions. A complete definition of EBM is: "an EBM matches the Web or EDI[7]-

7 EDI (Electronic Data Interchange) originated in the 1960s .Its intended purpose was to replace paper

based technological solutions implemented as a means of supporting the company's e-business strategy and value chain activities, including its business partner relations, with a view to creating value for the company and its clients"(CEFRIO, June 2003). So if a company wants to go into e- business and construct an EBM , it has to do a lot of things simultaneously: select the products and services sold on the Web, the markets to be courted, determine the nature of the internet-based relations it has with its business partners, choose a level of e-business integration for its operations, identify technological and select the deployment strategy that is best suited, while at the same time hooking up with the right business partners and ensuring the viability of its e-business project.

According to Paul Timmers [8] "e-business models should be understood as an "architecture for the organization of product, service and information flows".

- **E-shop**: it is created by a number of firms and is used as a place of their products exhibition. A firm's entrance to an e-shop contributes to the improvement of product quality, the reduced time of ordering and transaction process and firm's entrance to new markets. Nevertheless, adopting this type of EBM a firm cannot exploit the entire advantages e-commerce and Internet offer.
  - **E-procurement**: on contrary to e-shop which focuses on the product sales, the model of e-procurement is related the product purchase from suppliers. The dynamic of this EBM is based on the quality enhancement and the significant reduction of the purchase time.
  - **E-mall**: it consists of a large number of e-shops which enter in an e-mall in order to increase their value through their common promotion and presentation, quality guarantees and support of electronic payments. Usually, new intermediaries create these e-malls.
  - **E-auction**: it is a commercial process in which the participants interact and conciliate having special commercial roles. As well as in an e-mall, usually the person who provides an e-auction is a new intermediary. There are 3 basic types of e-auction (Marija Popovic, June 2002) :

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communication with electronic communication. This would increase the speed of communication and facilitate record keeping (e.g. There is no need for information from an invoice printed by one computer system to be retyped the other party). EDI is an e-commerce technology older than the World Wide Web that involves point-to-point communications done over proprietary networks, rather than over the Internet. Relative to EDI, Internet commerce offers considerable advantages in terms of cost and convenience. Internet commerce typically makes use of opens standards and off-the shelf technology on a global network, while EDI relies on customized hardware and software. However, despite the relative advantages of Internet commerce, the installed base of EDI connections will likely coexists with the Internet for some years into the future (Reiley and Spulber, 2000)

8 "Strategies and Business Models for B2B Trading, Electronic Commerce", Paul Timmers

- Standard (English) Auction: it is one in which bidders compete to buy something from a single seller. The bid price proceeds upwards and the highest bid wins the auction.
- Reverse Auction: it is one in which bidders compete to sell products or services to a single buyer, so the bid price proceeds downwards rather than upwards. As English auctions, reverse auctions may be organized as public or private auctions.
- Dutch Auction: it is a selling arrangement where the seller starts at a high price for an item and over time reduces the price. Buyers wait until an acceptable price is reached, then make a "bid" that fixes the price. The first bidder takes the item. On the Internet, the whole process is automated, which means that as the auction progresses, the price automatically drops down from the starting price every few seconds.

- **Virtual community**: it is from itself not only an EBM but also one opportunity that can be added to almost all the E-business models. The basic idea of the virtual community is the collection of participants with at least one common interest and the information exchange between the participants for this interest. Virtual communities are financially supported by advertising revenues and revenues from membership fees.
- **Collaboration platform**: on contrary to the aforementioned e-business models which do not support new processes, collaboration platforms are changing the nature of transactions between buyers and sellers and, hence, the nature of the relationship between them, by providing " a platform whereby business information (such as business plan, sales forecast, replenishment plan, promotion plan, product design etc.) is jointly derived, jointly affirmed, jointly executed and jointly measured against by all interested parties"[9]**.**This means that a collaboration platform must fully support many functions like market researches, negotiations, bargain striking, possible payments etc. The revenues of this EBM come from membership fees.
- **Third party marketplaces (TPMs)**: the provider of a TPM may be a new intermediary or a union of buyers or a union of suppliers and their role is to facilitate the commercial process between buyers and suppliers. In particular the provider of a TPM can enforce branding, offer financial services before

9 "The Dating Game: Searching for Liquidity with Collaboration or Sex, Liquidity and the New Economy", by Andrew While, Logility

and after the transactions, provide insurance and risk management. This EBM is considered of a great significance especially for the B2B transactions.

- **Value chain integration and service provision**: the providers of this EBM focus on more than one stages of the value chain in order to get advantage of the information flow between stages and, hence, add value to the product. Furthermore it is noticeable that usually this type of EBM specializes in a specific function of the addition value chain, like electronic payments or logistics, having as an objective to make this function their own competitive advantage.
- **Portal**: with guideline innovation it aims at serving firms and consumers through innovative piloting operations.

3.2 E-marketplaces

3.2.1 Classification according to the type of participants, the ownership structure and the industrial focus

The development of e-marketplaces was extremely rapid and extensive after 90s decade. This gave the incentive for the creation of various definitions for e-marketplaces by commercial and academic community. According to Bacos[10], e-marketplaces can help match buyers and sellers on the Internet by customizing product offerings, reducing buyers' search costs and supporting various price discovery strategies (e.g., electronic catalogue and electronic reverse auctions). They can also facilitate transactions between buyers and sellers by offering various value added services to their members (e.g. logistics services, credit verification). Hadaya[11] define e-marketplace as being an intermediary that allows buyers and sellers to meet on an electronic platform that rests on the Internet infrastructure in order to exchange information about products/ services (e.g. prices, specifications), conduct transactions online and adhere to other value-added services (e.g. settlement, distribution, integration, supply chain management) offered by the intermediary. Finally the IBM (2000) gave a more empirical and descriptive definition for e-marketplace: "An e-marketplace is an electronic gathering place that brings multiple buyers and sellers together. It provides to its members a unified view of sets

10 Bacos, J.Y. "A Strategic Analysis of Electronic Marketplaces", MIS Quarterly, 45 (3), 1991, p.p.295-310

11 "Determinants of the Future Level of Use of Electronic Marketplaces among Canadian Firms", Pierre Hadaya, Proceedings of the 37th Hawaii International Conference of System Sciences-2004

of goods and services and enables its members to transact using many different mechanisms available in the e-marketplace. The e-marketplace is created and maintained by a “market maker” who brings the suppliers and vendors together. The market maker assumes the responsibility of e-marketplace administration and performs maintenance tasks to ensure the e-Marketplace is open for business.

One of the main objectives of the e-marketplace is to drive out any inefficiency within the industry (Barrat and Rosdahl, 2002) and its key generic benefits are strengthened customer relationships, ease of reaching the market, improved efficiency and reduced costs and greater competitive advantage (HighBranch, 2003). However the rise and the fall of many “dot.com” firms in the beginnings of the new millennium has been unforgettable and justifiably has made both the companies and the investors extremely cautious about the performance and effectiveness of the e-marketplace, which is a specific type of business model in today’s digital world.

Typically there are two distinctive sides to any e-marketplace: the buy side and the sell side.

- The buy side represents businesses that use the e-marketplace for their buying needs, such as spot purchasing and/or addressing their enterprise-wide procurement needs.
- The sell side, as the name suggests includes businesses that leverage the e-Marketplace to sell their products via the transaction mechanisms offered in the e-marketplace.

The possible combinations in an e-market place are: B2B, B2C, B2G, C2B, C2C, C2G, G2B, G2C, G2G, where B is the first letter of Business, C means Consumers and G corresponds to Government. This can be meant as a classification of e-marketplaces according to the kind of participants. According to McConnell (2000), e-business has three primary segments:

- Business-to-customer (B2C)
- Business-to-business (B2B)
- Intranets or business-to-employee (B2E)

B2C covers customer interactions with an e-business site. Users may collect information, order products, and use support services through a Web site.B2B incorporates electronic processes such as supply chain or customers relationship management (SCM, CRM), as well as the online services such as trading or

procurement. B2E supports an organization's internal processes. Information is distributed through the Web and enables the employees to deal with more tasks on line. Among them, B2B is clearly dominant, representing 80% of the activities found in e-business (OECD, 2000) with significantly rapid growth. The present paper focuses on B2B e-marketplaces.

According to the industrial focus, there are two basic dimensions of e-markets:

- Vertical e- markets: they address industry-specific products and services (e.g. in the case of electric utilities a B2B exchange may offer transformers or environmental audits). The computers and electronics industry is one of the most attractive vertical e-marketplaces. Generally, the industries which have a tendency to favour vertical e-marketplaces are those with a large base of transactions and with many fragmented buyers and sellers that are difficult to bring together, therefore with a high search and comparison costs. Vertical e-marketplaces were established first within industries which are strongly pressed to cut high processing costs, such as costs of manual processes based on paper catalogues, telephone and fax ordering.
- Horizontal e-markets: as opposed to vertical e-marketplaces they do not focus solely on the needs of one particular industry. They deal with generic products and services, like office supplies or medical insurance, which are common to many industries. Thus far, most B2B participants in the utility industry operate in the vertical sphere. Industry experts argue that there is a place for both business models. Utilities will go to the vertical markets for specialty items, but for day-to-day needs, they will use the horizontal markets. Horizontal e-marketplaces were initially founded to support trading of MRO materials such as janitorial supplies, and other indirect (non- MRO) materials, such as office supplies. Nowadays they are more and more present in the services sector.

Last but not least the most popular classification of e-marketplaces is based on the ownership structure. There are three categories (Popovic 2002):

- Third-party (Independent) e-marketplaces: also called Fat Butterflies they are independent, neutral, Internet based trading platforms without having any owner neither a buyer, either a supplier. Their main function is to facilitate trade between buyers and sellers. Considering the large number and variety of participants targeted, they should not be expected to offer deeper

integration possibilities. The basic characteristics that distinguish independent e-marketplaces from other e-marketplace types are:

- Independent e-marketplaces represent a community of many buyers and sellers
- They attempt to meet the needs of both buyers and sellers avoiding any kind of bias
- They have open criteria for entry, which means that any business can participate if it agrees on the Terms and Conditions and is eligible to apply.
- Generally, but not always, an independent e-marketplace acts as an Internet based broker, in the sense that the e-marketplace itself doesn't take physical possession of the goods and services being traded, but rather just facilitates their exchange by matching buyers and sellers.

Independent e-marketplaces constitute a vast majority of e-marketplaces. They are typically private and therefore often dependent on venture capital. Small and medium sized businesses are in general an attractive market for independents because of their sheer size.

- Consortia e-marketplaces: they are constructed by industry leaders, known as "bricks and mortar" companies that dominate their respective old economy industries. By forming jointly an e-marketplace, traditional companies aims at concentrating a substantial portion of their industry trading volume. If the founding companies are strong enough, most of their suppliers and buyers will be enforced to join their network. They constitute automatically critical mass and provide liquidity for the transactions. Consortia e-marketplaces emerge typically within a vertical supply chain in the following situations:
  - Buyer-driven e-marketplaces: they emerge when the side of demand in an industry is characterized by a large concentration of some dominant companies, whereas the side of supply is fragmented and often inefficient. One example of this kind constitutes the e-marketplace "Convisint", which has been created by the largest automotive industries for their transactions with their supplies.
  - Supplier-driven e-marketplaces: they emerge when the side of supply is concentrated by a large concentration of some dominants suppliers, whereas the side of demand is fragmented among a huge number of smaller companies. The steel industry makes a perfect example. One

example is the e-marketplace “GXS”, which has been created by the largest puddling companies for their transactions with their buyers.

- Private exchanges: unlike public exchanges, where anyone can participate, private exchanges are set up by individual corporations to deal solely with their own suppliers/buyers. While their technical infrastructure resembles the one that public e-marketplaces rely on, the private e-marketplaces generally provide more complex capabilities, such as joint planning and synchronized production processes. Large companies may decide to establish their own exchange rather than to join a public one because private e-marketplaces offer greater data privacy and security, offer a possibility to transfer the deeply rooted behavior patterns of the company and its supply chain particularities online and choose the method that suits best and finally avoid the immature capabilities of public e-marketplaces. Dell Computer Corporation is one of the most successful private e-marketplaces and its ambition in developing a private exchange is to achieve a constant state of balance between supply and demand.

Moreover it has to be mentioned that many companies adopted the portfolio approach, which incorporates strategies that leverage multiple e-marketplaces. Their objective is to eliminate risks caused by market uncertainty. By creating a portfolio of e-markets, a company can optimize everything from community content to supply chain collaboration. For example Dow Chemical is involved in several different e-marketplaces to best meets its divers needs. The main problem in this strategy is that it can be difficulty workable on small companies, as the adherence to each additional e-marketplace brings additional expenses that small companies could not possibly cope with.

3.2.2 The role of the intermediary in B2B e-marketplaces

In economic theory intermediaries are usually companies that sell the product but they don’t create or consume it. In the traditional structure of markets they are valuable because of the existence of transaction costs in markets. As transaction costs we mean the costs that are created during the process of the transaction between the two sides (buyers and sellers) but are not related to the production costs. As Coase (1937) and Demsetz (1968) said, these transaction costs can be limited by the incorporation of the “firm” into the market, as firms can be proved efficient for the reduction of the transaction costs.

Several roles of intermediaries have been identified in the literature. For instance, Resnick, Zeckhauser, and Avery suggest that brokers are important in markets because search costs, lack of privacy, incomplete information, contracting risk and pricing are better managed through a broker. Malone, Yates and Benjamin define similar reasons to have intermediaries: reducing coordination costs, addressing problems of asset specifity and promoting standardization. Williamson's transaction cost theory builds on Coase and offers a theory of firm boundaries by arguing that the cost of contracting, enforcing the contracts and dealing with unforeseen circumstances varies depending on whether a market or a hierarchical structure is employed. Actually the role of the intermediary depends on the type of the transaction he participates and there is a confusion between the complex definitions of the intermediary's roles.

Nowadays, information and communication technology (ICT) helps firms to reduce the transaction costs they deal with. However the role of the intermediary remains important in the new economy not only for the reduction of the transaction costs in the commercial activities but also because of the specific characteristics of the Internet. Reiley and Spulber (June 2000) defined four main types of e-commerce intermediaries, ordered roughly in terms of the participation of the intermediary in the exchange. The participation of the intermediary is primarily defined in terms of the pricing mechanism and whether or not the intermediary transfers ownership of the goods and services. The four types are:

- Brokers. Brokers match buyers and sellers for a fee. Some brokers offer simple referral services, providing buyers with information about sellers. These services somewhat resemble yellow-page directories, but with more comprehensive information and search facilities. Sellers may pay fees to be listed, or to provide additional information about themselves, while buyers generally do not pay for access. Buyers can then contact sellers through links to their Web sites, and through email or offline communications, see Kaplan and Sawney (2000). Some broker sites also allow sellers to place listings, resembling classified ads, for specific products. At the sites of more comprehensive B2B brokers, sometimes called "catalog aggregators," buyers can view catallogs, containing information about products and prices from different sellers. These catalog-oriented brokers take orders for products on the sellers' behalf, typically leaving order fulfillment up to the sellers themselves.

- Auctioneers. Auctioneers take a more active role in the transaction by setting up a mechanism to determine the transaction price. Internet technology significantly reduces the cost of running an auction relative to using posted prices, and auctions may be particularly useful in situations where there is enough uncertainty to make it unclear what the market-clearing price should be. Auctions have become popular among individual consumers on the Internet; see Lucking-Reiley (2000). In B2B e-commerce, sellers have held auctions of surplus inventory, including items as diverse as rolls of steel and advertising space. Buyers have held reverse auctions, in which sellers compete against each other for a procurement contract. FreeMarkets Online is perhaps the largest "reverse auctioneer," having assisted in procurement for clients..
- Exchanges are double-sided markets, similar to existing markets for financial instruments and some commodities (such as those traded on the Chicago Mercantile Exchange), but B2B firms promise to extend such markets to a variety of new products, including manufactured goods, primary inputs, and services. Exchanges provide a host of services including rules for trading, price transparency, and centralized clearing.
- Dealers. Dealers take ownership of goods provided by suppliers and resell them to buyers. Dealers post ask prices for buyers and bid prices for sellers. They earn returns from the bid-ask spread, adjusting prices to changes in market conditions. At the early stages of development of B2B ecommerce, few of the new on line companies have attempted to become dealers. Instead of building the physical infrastructure required for inventory and shipping, most have chosen to focus on building the electronic infrastructure of markets (broker, auction, or exchange).

The most widely known type of intermediary in an e-marketplace is the broker, who doesn't have the ownership of the products like resellers have, but makes easier the transactions between buyers and suppliers. Humphey (2002) summarizes some of the most basic services that infomediaries[12] provide having taken under consideration literature about the role of intermediaries in e-marketplaces. The classification of the services has become according to the type of the transaction costs they reduce. An intermediary may reduce search costs or coordination costs or information asymmetries e.t.c.

12 Intermediaries in e-marketplaces

However popular discussions often suggest that efficiencies in B2B e-commerce are obtained by disintermediation: “cutting out the middlemen,” or supplanting presumably costly intermediaries with direct transactions. Reiley and Spulber (June 2000) came to disagree with these opinions by saying that if B2B e-commerce encourages outsourcing to replace some transactions previously internal to the firm, the end result would be more intermediation rather than less. Furthermore, much B2B intermediation is targeting inefficient direct meetings between companies and their suppliers, which would also increase the amount of intermediation activity. According to Bacos and Bailey (1997) the movement to electronic markets does not seem to result in the elimination of intermediaries, as electronic markets will require intermediation services, albeit in ways that differ from traditional physical markets. For example in their survey Bacos and Bailey they found that need of intermediaries as providers of trust may decrease once an adequate legal framework for electronic commerce, like an EDI or a value-added network (VAN), is in place but at the same time it increases because the overwhelming abundance of information offered by Internet based market infrastructures render essential the existence of intermediaries in order to match customers and suppliers by filtering this information.

Intermediaries in e-marketplaces get revenues by charging the participants-firms with several types of fees. These fees vary in proportion to the user of the e-marketplace and the extension of the usage of the electronic services. According to eMarketServices (2003) the primary sources of revenues for the infomediaries are:

- Membership fees
- Commission-based fees/percentage of the value of the transaction
- Transaction fees/fees per completed transaction
- Fees for suspension of corporative catalogue
- Advertisements
- Renting or selling of software of e-commerce
- Fees for consultive, logistics services etc.

This time membership fees are considered as the most popular pricing instrument for the brokers.

3.2.3 Importance-objectives of B2B e-markets and motives for B2B e-market participation for both parties (buyers and suppliers)

As it was mentioned before, B2B e-commerce is clearly dominant in e-business.

Within the fastest growing segment of the Internet economy knowing as e-commerce, B2B e-commerce is considered to have the brightest prospect of future growth and expansion. Gartner group defines an e-marketplace as "an enterprise that brings together buyers and sellers in particular industry, geographic region, or affinity group, for the purpose of commerce"[13]. Reiley and Spulber (June 2000) gave their own definition: "Business-to-business refers to a broad range of intercompany transactions, including wholesale trade as well as company purchases of services, resources, technology, manufactured parts and components, and capital equipment. B2B also includes many types of financial transactions between companies, such as reinsurance, commercial credit and electronic networks for trading bonds, securities and other financial assets. B2B transactions exclude those involving households, such as retail sales, interconsumer exchange, and employment".

Businesses from nations all over the world now use B2B e-commerce to purchase over a trillion dollars in goods and services every year; something traditional methods and technologies designed to facilitate procurement could not accomplish. The first electronic procurement system was electronic data interchange (EDI) networks. EDI processed high volumes of information in batches and translated those orders for receiving networks (Dale Boeth). These networks revolutionized the way major corporations purchased basic supplies by allowing them to submit requests directly to the distributor, reducing errors, lowering transaction times and significantly cutting paperwork, while lowering costs. EDI is however extremely static and restrictive and the technology is expensive and not a viable option for most businesses. Moreover, the systems are expensive to maintain and provide no community or market transparency. In short, it is not an environment in which new avenues of commerce could grow. For greater mobility, both buyers and suppliers applied the Internet to supplement or replace their existing EDI systems and this happens with their participation in B2B markets. B2B has two major components: "e-frastructure" and "e-market". Auctions solutions software,, content management software, and web-based commerce enablers constitute the term "e-frastructure". On the other hand, "e-market" is the place where B2B e-commerce takes place and both buyers and suppliers come together to communicate, exchange ideas, advertise, bid on auctions, conduct transactions and coordinate inventory (Apte and Nath, 2004).

It is widely known that many of the B2B operators have failed because they were not

13 "The evolving New Economy", Gartner Special Report

able to reach a critical mass of participants to ensure enough liquidity and as a result an Internet "bubble" came up. However some new operators managed to survive and reached the break-even point by making the essential changes in their business model or by "investing" on a portfolio of electronic services. Porter (2001) suggests that Internet does not offer a radically new approach to business but instead offers a set of tools that can complement traditional ways of competing and buttress existing advantages. In other words the participation in B2B markets and the adoption of e-business technologies can be considered as a way of creating value for buyers and suppliers. There is an extensive literature on the beneficial effects of B2B markets. Ordanini (September 2003) showed through an empirical survey that participation in B2B markets might have three different kinds of impact on the users, which can be clearly considered as significant benefits for them. These impacts are:

- Negotiations effects: for suppliers their participation in B2B exchanges gives them the opportunity to find new customers easily and increase sales, leading to market exploitation. In addition small suppliers have the opportunity to expand globally by entering B2B markets that were once unknown to them or closed to them due to the high costs of EDI (Milligan 2000, Porter 2001). For buyers negotiations effects mean an increase in the number of suppliers [14] and savings on purchasing costs, which results in the increase of their bargaining power. This ability is typically developed within the procurement department.
- Efficiency effects: they are based on the streamlining of internal procurement processes. This streamlining encompasses three basic functions: the reduction in administrative costs, the time optimization (e.g. eliminating the time and money spent on distribution by mail and fax. E-mail can be sent any time during the day or night to reduce time wasting "phone tag") and the improved quality of processes (e.g. Web-based self service enables customers to update their own shipping and billing profiles, place orders, view order status, and access online support from customer service representatives through e-mail response management chat)
- Partnership effects: B2B exchanges facilitate processes like information sharing, learning from other's experience, knowledge sharing and provide a broad range of supply chain management services, including digital catalogues, online auctions, logistics services, supply chain planning and even design collaboration. Except for the streamlining of procurement

14 "Internet exhibits an almost magical ability to remove geographical barriers", Brodsky 2001

process, a B2B market can create much more value through a coordinated supply management. In particular supply chain partners can participate in B2B markets in order to share production schedules and inventory levels in real time, providing clear visibility of demand. So with reduced supply uncertainty, all firms in the supply chain can safely lower inventory levels and costs without fear at stock-outs (Kalakota and Robinson, 1999).

According to Kaplan and Garicanoi, the key effect and benefit of B2B markets is to change the costs and benefits of transacting. These changes can improve efficiencies with two ways: firstly it may simply reduce the cost of an activity already being conducted (e.g. the automation of a transaction that is currently conducted by phone or fax) and secondly it provides an opportunity to redesign the existing process. For example, Autodac creates on-line auctions for used cars without having to ship the cars to a physical auction. Undoubtedly this change in the process reduces transportation costs and time for both buyers and suppliers.

Another classification of the impacts-benefits of B2B markets has been made by Eng (October 2003) on the basis of the supply chain services they can provide. Before mentioning the two kinds supply chain services it is worth giving a description of the widely known term “Supply Chain Management”. Supply Chain Management has been described as the chain linking each element of the manufacturing and supply process from raw materials to the end user, encompassing several organizational boundaries (New and Payne, 1995, Scott and Westbrook, 1991).Christopher (1998) also notes that the goal of supply chain management (SCM) is to link the market place, the distribution network, the manufacturing process, and the procurement activity in such away that customers are services at higher levels and yet at a lower total cost. According to Eng (October 2003) B2B markets provide two kinds of supply chain services:

- Transaction-based supply chain services. A transaction-based supply chain service includes transactions that do not rely on relationship and technical development such as auctions/ reverse auctions, catalogues, communication and exchanges, ordering/payments, buyers/sellers search. The primary benefits that could be derived from a transaction-based supply chain service concentrate on automation of processing orders, payments and deliveries, reverse auctions, inventory clearance, scheduling on line catalogues, negotiations and 24- hours availability.

- Strategic supply chain services. They are characterized by long-term orientation and exchange of strategic among participant organizations. The main components of strategic services focus on collaborative planning, forecasting, and replenishment (CPFR) for efficient customer response. Eng through empirical research found that the benefits of strategic supply chain services are primarily centered on communications and efficient exchanges processes. Other benefits that follow are: efficient product introduction, streamlined electronic processes and increased customer satisfaction.

Both buyers and suppliers are motivated to participate in B2B markets not only because of the aforementioned benefits they will reap by this participation but also because of the loss they will have if they do not participate. However the motives of buyers and suppliers for B2B market participation differ according to case studies accomplished by Rask and Kragh (2004). Strandskov (1995) proposed a very useful categorization of motives for participating in B2B markets based on two dimensions: drivers and the nature of the decision as it can be seen from Figure 1.

Figure 1. Motive indicators for B2B e-marketplace participation

		Drivers	
		Internal	**External**
Nature of decision	**Planned**	**Efficiency**: the decision to participate in a B2B market is driven by an internally generated wish to obtain company-specific advantages and is made as a consequence of the careful evaluation of expected outcome. • Price reduction • Process time reduction • Cost reduction	**Positioning:** the driving forces behind the decision to participate in a B2B market are industry-specific competitive conditions. The decisions are planned and taken with the purpose of improving the competitive position of the company. • Increased buyer/supplier reach • Avoidance of dependency • Increased bargaining power
	Emerging	**Exploration:** Initial B2B participation takes place on a trial-basis and the decision to continue or discontinue participation is a direct result of actual experiences. Decisions are internally motivated. • Test of new markets • Test of new processes • Explorative learning	**Legitimacy:** B2B participation is motivated primarily by external drivers rooted in a company's relationships with other companies and happens as a consequence of ongoing political negotiations rather than careful planning. • Following existing buyers/suppliers • Technological sophistication • Marketing activities of B2B markets • Imitation of the behavior of competitors

From case studies it was found that in the case of buyers the prospect of obtaining

efficiency gains is the most cited reason for B2B participation and the second most cited reason is positioning. As regards suppliers, the most cited reasons for B2B participation are positioning and legitimacy. Also it is significant to mention that for most buyers the decision to move procurement activities to B2B markets has been planned, whereas suppliers are less deliberate than buyers. This happens due to the fact that suppliers have a lower level of awareness of B2B channels for buying and selling than do buyers, which means that they need to be pulled into participation more than buyers do. Finally for most suppliers motives are external, meaning that they need external stimuli in order for them to consider joining B2B markets.

3.2.4 Keys of success and future use of B2B e-markets / proposing ways of value creation in B2B e-markets based on evolutionary strategies and relationship management

According to Brunn (2002) without a clear focus, a B2B market takes the risk of trying to sell everything to everybody and this is likely to result in selling nothing to anybody. As a consequence an essential component for the success of the B2B market is the determination of the targeted buyers/suppliers and the type of products available in the specific B2B market. It is of a high importance that suppliers, customers and if possible intermediaries will clearly identify their objective and make their assessment. Proper market determination enables a B2B market to dominate its chosen market segment quickly, encouraging share and liquidity and in turn facilitating scaling up quickly. It also enables a B2B market to tailor its business model to match the target market's distinct characteristics (Sculley and Woods, 2000). In addition due to the continuously increasing product complexity, the products or services available in B2B markets should be more effective, developed and specialized in time and the knowledge for these products/services should be unique and not easily reproduced (CAPS, 2000). For the accomplishment of this uniqueness, services like industry know-how, e-commerce know-how and conceptual know-how are appropriate (Kalakota and Robinson, 2001). Another key of success of B2B markets is its attractiveness level, which depends on the dynamic of the presented services and the level of interaction and cooperation with the customer (e.g. brand and reputation makes a B2B market more attractive).

The economic success of a B2B market depends on the volume of business conducted. So is important for a B2B market to achieve liquidity. The possibility of a

business's survival will be higher if liquidity is achieved early, because having the greatest liquidity transforms into market domination (Sculley and Woods, 2000). In addition to liquidity, for a promising start it makes sense to focus on key players (suppliers with the most complete product portfolios and buyers with the higher benefits from using the B2B market) in a given industry. Another important factor for the economic success of a B2B market is the identification of the most appropriate way of charging its customers (transaction fees or subscription fees or license fees…), having taken into consideration which are its key customers and its competitors B2B markets. On the other hand, obstacles in the economic success of a B2B market are the fragmentation of suppliers/buyers and the difficulties of bringing them together (Brunn, 2002).

Except for the above, it is vital for a B2B market to have a good management structure, which will contribute to the electronic transformation level of the processes and provide the rules for the exchange, the elimination of conflicts and the decision-making support (Ramsdell, 2000). Also, setting up a B2B market with the right technological platform by using a sufficient competency level has a strategic importance as it is directed to the consequences for the success of the B2B market (Brun 2002, van der Heijden, 2001). In particular the technological platform should be able to support the development of advanced market making tools (i.e. different catalogue structures and auction types), integrated procurement tools (e.g. searchable catalogues and administrative tools) and advanced collaboration tools (Brunn, 2002). Last but not least, the success of a B2B market depends on external conditions (political, cultural and economic) and on the readiness level of the industry to enter the B2B market (e.g. some industries such as utilities or computing and electronics are more supportive for a B2B market success because of their product fit and industry readiness).

Unfortunately there are very few empirical studies on the factors that contribute to the future use of a B2B market. Hadaya (2004) found through an empirical study that the future use of a B2B market primarily depends on the pressure exercised by consultants and other experts. They seem to play the role of opinions leaders by providing information and advice about the innovation to firms, inciting them to adopt this new type of electronic platform and also providing them technical support during the implementation process. Other significant determinants of the future use of a B2B market are:

- The level of dependence (+)/collaboration (+)with key suppliers[15]
- The level of dependence (+)/collaboration (-) with key customers
- The firm's past experience in e-commerce (+)
- The complexity of sophisticated e-commerce (-)
- The firm's volume of exports (+)
- Industrial sector
- The pressure exercised by competitors (-). There is a negative relationship between this determinant and the future use of a B2B market, because a firm that is not threatened by the e-commerce strategy of its competitors is willing to join the same B2B market than the latter, or still develop one in partnership with them (consortium e-marketplace)

Through a study of Laseter and Bodily (2004), it was found that consortia ownership provides an advantage to a B2B e-marketplace in achieving revenues but does not speed time to profitability.

It is generally evident that B2B e-markets have the prospectives to become much more successful gradually. There are many ways that can add value to them, one of which is the evolution of cooperative buyer-supplier relationships (Anderson & Narus, 1998; Peppers & Rogers, 2001). Due to the fundamental change in the source of competitive advantage of the vertically integrated industrial companies, costumer relationship management (CRM) starts to become of vital importance. Traditionally suppliers were focused on economies of scale, which rely on the cost reduction potential created by mass production, whereas in today's network framework the basic aim of the suppliers is the implementation of an integrated process that enables the rapid introduction of new products, enhances product quality, and reduces costs all at the same time. In other words their focus was shifted from economies of scale to economies of scope. As a result, incentives are created for suppliers to differentiate themselves in their field in order to satisfy the increased demands of the buyers and the basic prerequisite for creating a sustainable competitive advantage is based on the coordination of the buyers' and sellers' processes. Ehret (2004) supports that nowadays dynamic value networks like B2B e-marketplaces constitute the context for the creation of customer value and the management of relationships more so than do traditional stable "value chains". CRM becomes the job of key accounts managers, which function as the customer's agents throughout the the supplier's organization. One strategic issue, which leads to successful buyer-supplier

15 The symbol (+) identifies a positive relationship between the future use of B2B markets and the corresponding determinant, whereas the symbol (-) identifies a negative one

relationships is the management and guarding of specific investments, such as relationship-specific knowledge, information systems, collocation of assets, e.t.c. (Ehret, 2004).

In addition Hackney, Burn and Salazar (2004) study the importance of a “co-evolution strategy” for value creation in electronic markets. By saying co-evolution strategy they mean a framework, which encompasses critical elements such as e-market ecosystems, e-alliances, e-knowledge and e-systems. The e-market ecosystem can be viewed as the all-embracing e-market culture within which an organization maintains equilibrium. So an organization which undertakes strategic planning without understanding the impact on the e-market ecosystem is ignoring the reality of the networked environment in which it operates (Iansiti and Levien, 2004). E-alliances are increasingly becoming an important element for long-term survival of an industry. A good example of purposeful partnership in the Chemical Industry is a consortium of 12 major chemical companies, which created a global e-commerce exchange having as an objective to lower transaction costs for suppliers and clients. Current e-systems have not only evolved into sophisticated technological platforms that integrate supply chain management (SCM) and costumer relationship management (CRM) systems but also enables strategic partner alliances, market positioning and knowledge dissemination and creation (Ash and Burn,2003; Rashid et al.,2002;, Mandal and Kim, 2002; Yamada, 2003). Finally e-knowledge refers to the external sources of knowledge of an organization that can be exploited through the value network of strategic alliances, creating in this way knowledge advantage for the company. Besides, nowadays industries operate in a knowledge-based environment, which makes the role of knowledge sharing and as a result knowledge spillovers very important in the success of a company and at the same time e-knowledge becomes a driving force for the success of a firm in a B2B e-market. In today's e-markets, knowledge networks has become one of the most strategically important resources and learning the most strategically important capability (Larsson et al., 1998; Zack, 1999; Macleod, 1999; Hansen et al., 1999; Buchel and Raub, 2002)

3.2.5 Generally about technological spillovers / Technological spillovers in e-markets.

The relationship between technological progress, innovation and growth appears to have changes in the 1990's. The ways in which organizations interact in an economy

have been affected with networking, co-operation and the fluid flow of knowledge within and across national boundaries gaining in importance. In this changing environment, innovation has become more market- driven, more rapid and intense, and more widely spread throughout the economy. Information and Communication Technology (ICT) has played an important role in facilitating innovation, particularly since the recent emergence of the Internet, The World Wide Web, and the electronic commerce, by significantly reducing the the costs of outsourcing and cooperation with entities outside the firm. ICT is a key technology for speeding up the innovation process and reducing cycle times, it has fostered greater networking in the economy and it makes possible faster diffusion of codified knowledge and ideas (OECD, 2000)

Unlike neoclassical growth models, technological change is no longer treated as exogenous and increased R&D activity creates externalities through technological spillovers that make economic growth sustainable.[16] Technology spillover is frequently misunderstood or confused with other related issues such as technology adoptions or transfers and is often used interchangeably with R&D spillovers. The most important characteristic of technology spillovers is that they are indeed externalities. Technology spillovers occur when a firm receives economic benefit from another firm's R&D activity without sharing any cost. That is, the most significant difference between technology spillovers and transfer is whether the innovator can appropriate the welfare surplus from the transfer of knowledge. Griliches (1979, 1992) identified two different types of technology spillover concepts. In practice, however, it is difficult to separate them operationally. The first type is often called a vertical, welfare, pecuniary, or rent spillover. In this case, research performed in one firm (seller) can benefit another firm (buyer) because the quality improvement embodied in inputs is often not appropriated fully by the seller because of competition. Thus, this type of spillover focuses on transaction-based linkages and usually occurs along buyer-supplier chains. In welfare terms, a cost-reducing innovation of a seller firm lowers the cost for a buyer firm and thereby increases the level of the buyer firm's producer surplus. Such welfare effects, however, rarely show up in transaction data because the price indexes do not correctly reflect quality improvements in a timely manner (Mohnen, 1990).

The second type is often called a horizontal, knowledge, nonpecuniary, or technological spillover. This is basically a question of knowledge transmission. Research

16 According to Romer (1990) knowledge is a partially excludable and non-rival good, and thereby gives rise to knowledge spillovers.

per-formed in one firm can stimulate the creation of new knowledge or the fruition of previous ideas in another firm. In this case, new knowledge is disembodied from new goods and becomes part of a general pool of knowledge (i.e., public goods). Subsequent innovations are built upon this disembodied pool of knowledge. It is the kind of spillover that begets further innovations and changes the production capacity of an economy. Thus, this type of spillover focuses on technology-based linkages and can occur without direct input-output linkages among industries. One illustration of technology-based linkages is the "technological closeness" concept developed by Jaffe (1986). It assumes that one industry may benefit from new discoveries made by another industry if the two industries use similar processes (not necessarily connected by value chains). The second type of spillover, is a question of knowledge (or technology) as a partial public good. Since knowledge is a partially non-rival and non-excludable commodity, borrowing an idea from someone else's research will not reduce the available knowledge stock for the original innovator. However, it can erode the returns from an innovation if the leaked knowledge helps competitors imitate. In other words, it is the result of unique characteristics of knowledge as a commodity.

Specifically, in this thesis we focus on the second type of involuntary knowledge flows (or knowledge spillovers). Knowledge spillovers arise when part of the knowledge generated by an organization spills over its boundaries and becomes available to other organizations (Nelson, 1959; Arrow, 1962). In other words technology (or knowledge) spillovers are the unintentional transmission of knowledge to others beyond the intended boundary (Fallah, Ibrahim) on contrary to technology transfers which mean knowledge exchanged with intended people or organizations. The unintended "use" of exchanged knowledge is called "Knowledge Externality". Technology spillovers stem from tacit and explicit knowledge sharing[17]. In particular, people share knowledge for different reasons, for example, to get feedback from other people, or to receive acknowledgment of ones ideas, this acknowledgment could be materialistic or simply recognition between peers for the work done. Once this knowledge is out there it can be used in any way to benefit other peoples' work and could lead to other discoveries. Hence sharing knowledge could result in spillovers and other knowledge externalities. Several papers have highlighted the

17 Polanyi (1996) classified knowledge into two types: tacit and explicit. Tacit knowledge is the "knowledge that indwells in a comprehensive cognizance of the human mind and body" and in consequence has a personalized quality that needs to be articulated by the individual in order to be communicated. Explicit knowledge codified knowledge that is transmitted using olderly formal languages

importance of knowledge spillovers for strategic decisions at the firm level. For instance, Jaffe (1986) and Bernstein and Nadiri (1988) investigate the impact of spillovers on firms' productivity and performance. Cohen and Levinthal (1990) and Geroski (1995) analyze the effect of knowledge spillovers on firms' incentive to perform R&D. Cassiman and Veugelers (2002) study the relationship between R&D cooperation and spillovers. Finally, Jaffe et al. (1993) and Almeida and Kogut (1999) underline the importance of geographical co-location in order to benefit from knowledge spillovers, whose effects have been shown to decay with distance. Also, Griliches (1992) states, "spillovers are present in clusters and their magnitude may be quite large".

The amount of knowledge (technology) spillovers available to a firm depends on the density of firms' clustering in a given geographical area, on the sector, the nature of knowledge, and the legal protection of intellectual property, among other things (Jaffe et al., 1993; Teece, 1986; Saxenian, 1996). The centrality of knowledge spillovers in the process of knowledge generation and innovation is at the root of the formation of formal or informal networks[18] , which means that when a firm decides to become a member of a network it can take a greater advantage of the existent technology spillovers. Local collaboration can be considered as one of the most widely known networks. Although all firms located in a given geographical area and belonging to a given network might equally benefit from the presence of knowledge spillovers, in practice, they differ in their ability to identify and exploit such spillovers and, therefore, the effect of knowledge spillovers is unequally distributed across the population of firms. However in today's "virtual" economy of computers and electronic commerce, there is a larger transparency of tacit and explict knowledge spillovers and firms can increase their capability to absorb these spillovers through their participation in a B2B e-marketplace or much better in a local e-collaboration platform (an electronic type of network).In today's " digital economy", due to the great diffusion of ICT, local e-collaboration undoubtedly constitutes a very good proposition for local firms, because through their participation in this type of electronic network , they can make use of ICT, fulfill common goals and exploit technological spillovers (Kourgiantakis & Petrakis, 2006).

18 Despite widespread use there is no agreement on the appropriate definition of networks. The definition offered by Robert Tijssen (1998, p.792) captures perhaps the most important features characteristic for the network mode of organisation. He defines a network as 'an evolving mutual dependency system based on resource relationships in which their systemic character is the outcome of interactions, processes, procedures and institutionalization.

Nowadays the digitization of information and information-intensive products are conducive to bring about the new knowledge-based economy[19]. A reason for this development is that digital goods behave like knowledge or experience, and modern ICT broadens and accelerates knowledge flows contributing to the creation of new innovative opportunities. As a result unlike firms in a traditional B2B marketplace, firms that participate in a B2B e-marketplace face their goods more than a kind of knowledge (or technology) and thereby they are more familiar with innovations and investments in R&D (or new technologies). It is obvious that in an e-marketplace the flow of information and knowledge has taken the place of the flow of goods. In the framework of the information digitization, there is an emergency for lifelong learning and training the requirements for innovative or imitative capability of organisations demanding continuous or long-lasting R&D efforts, technology diffusion and transfer. Besides, one basic component of B2B e-marketplaces is Interorganizational Information System (IOS), a unified system which facilitates information flow between two or more organizations through communication networks. So, it is of vital importance to examine the role of technology spillovers within the framework of a B2B e-marketplace and in this master thesis we focus on the independent B2B e-marketplace, where an intermediary exists and its role is to facilitate the transactions between the upstream firms (or suppliers) and the downstream firms (or buyers).

19 The knowledge- based economy is defined by the OECD (1998) as an economy that is directly based on the production, distribution and use of knowledge and information.

4. METHODOLOGY

Having clearly identifying the objective of this master thesis in the second section, it is important to choose the most appropriate method followed for drawing out the most trustworthy conclusions. There are several methods that can be used in order to come to some conclusive points, but in proportion to the specific objective of the project there is one method, which is more suitable and more easily applicable than all the others. One of the main characteristic of this study is the strategic interaction between players (upstream and downstream firms and the intermediary), meaning that players pursue well-defined exogenous objectives and take into account their knowledge or expectations of other player's behaviour. As a result game theory is the most suitable method in this case, because it constitutes a bag of analytical tools designed to help us understand the phenomena that we observe, when decision makers interact. Econometric analysis comes behind game theory in this case because there are qualitative factors that cannot be introduced into an econometric model and moreover the strategic interaction between players makes the construction of an econometric model difficult and complicated. The theory of competitive equilibrium is also considered useless in this case, because unlike game theory, which takes into account the attempts by each decision-maker to obtain, prior to making his decision, information about the other players' behaviour, competitive reasoning assumes that each agent is interested only in some environmental parameters (such as prices), even though these parameters are determined by the actions of all agents.

In this research there are three groups of players within the framework of a vertical independent B2B e-marketplace: upstream firms (or suppliers), downstream firms (or buyers) and the intermediary, which facilitates the transactions between the two sides of e-marketplace and charges both sides with membership fees and commissions. The player in each group takes a different kind of decision, and thereby the game examined is multi-stage and every stage represents a different type of strategic decision. The main question in this study is: which will be the impact of technology spillovers among downstream firms on

1. The production decisions (output-input quantities) of downstream (buyers) and upstream (suppliers) firms in an e-market?
2. The investments in output quality enhancement?
3. The pricing policy of the intermediary?

By extending Kourgiantakis et. al. (2007) analysis, we introduce technological spillovers in a vertical third-party B2B e-market, which like in Milliou and Petrakis paper (2003), arise from the diffusion of information about the quality improvements of each downstream firm's final product. As a result of the introduction of technological spillovers among downstream firms in this thesis, downstream firms compete not only in quantities but also in the quality level of their final product. The extent of technological spillovers now plays a very important role in the strategic decisions of all types of players (downstream firms, upstream firms and the intermediary) and this exact impact will be examined. As it was aforementioned, each stage of the game represents one decision of strategic importance for every decision makers' group. In this study a fourth-stage game arises and is the following[20]:

- Stage one: The intermediary determines membership fees and commissions for both upstream and downstream firms, which are members of the B2B e-marketplace.
- Stage two: Downstream firms compete in the level of quality upgrading investment.
- Stage three: Upstream firms compete in quantities of their input (Cournot competition).
- Stage four: Downstream firms compete in quantities of their final product (Cournot competition)

This game of perfect information will be solved with the principle of backward induction, beginning from the last stage and going on until the first stage. According to this principle, each player's strategy must be a best response to the other players' strategies, not only when the game begins at the initial node of the tree, but also when the game begins at any other node (Selten, 1965, 1975). Backward induction principle gives rise to the following "subgame perfection": *The equilibrium of the full game must induce an equilibrium on every subgame.*[21]

20 The fouth-stage game is better analysed in the following section.

21 A subgame is a part of the tree consisting of a single node (the root) and all the branches following it, and which has the property that every information set intersecting it is fully contained in it.

5. THE MODEL

Consider a two-tier industry consisting of n_b downstream firms - final good producers and n_s upstream firms – input suppliers. The upstream, as well as the downstream firms are identical. The upstream firms (suppliers) produce a homogenous input and the downstream firms (buyers) produce a homogenous final good transforming one unit of input into one unit of final good. All transactions between the two sides of the market take place on a vertical B2B e-marketplace, which is owned by an independent intermediary. It is assumed that the intermediary offers the only platform in which buyers and suppliers can make transactions. It is further assumed that the intermediary does not own or price any of the inputs exchanged in the e-market; he only provides services to facilitate buyers-suppliers interactions. The e-marketplace owner is a profit maximizer who disposes two price instruments: the membership fees charged to every participating firm in the e-marketplace and the commission fees charged for every unit exchanged in the e-marketplace commissions.

The utility of the representative consumer is given by the following quasi-linear function:

$$U(q_1,...,q_{n_b},x_1,...,x_{n_b}) = \sum_{i=1}^{n_b}(a + x_i + \lambda \mathrm{X}_{-i})q_i - \frac{1}{2}(\sum_{i=1}^{n_b} q_i^{\,2} + 2\sum_{i=1}^{n_b}\sum_{j\neq i} q_i q_j) - \sum_{i=1}^{n_b} p_i q_i + m$$

The variables q_i and x_i denote respectively the quantity and the quality of the downstream firm *i*'s product *i, j=1, 2,..., n_b, $i \neq j$,* while m represents the representative consumer's expenses on the rest of the goods. The total quantum of quality x_i, that characterizes firm *i*'s product depends on the amount of quality improvement firm *i* makes as a result of its own investments in quality. The above utility function implies that each consumer spends only a small part of his income on the products of the industry under consideration. As a result, income effects on this industry can be ignored and a partial equilibrium analysis can be applied.

The solution of the utility maximization problem of the representative consumer leads to the inverse demand function faced by each downstream firm *i*, $p_i = \alpha + x_i + \lambda X_{-i} - q_i - Q_{-i}$, where $Q_{-i} = \sum_{j\neq i} q_i$ denotes the aggregate output produced by its rivals and X_{-i}

$= \sum_{j \neq i} x_i$ denotes the total amount of quality improvement made as a result of its rivals' investments in quality. The parameter λ denotes the degree of technological spillovers among downstream firms where $0 \leq \lambda \leq 1$. It represents the extent to which information about the quality improvements of its competitors becomes freely available to the final producer *i*. If technological spillovers among downstream firms are full, i.e. λ=1, firm *i* can fully enjoy the quality improvement attained by its competitors. In the opposite case, i.e λ=0, firm *i* cannot take advantage of its competitors' quality improvement. It can be easily seen that the quality level x_i of firm *i*'s final product increases the consumer's willingness to pay for firm *i*'s product. Through the diffusion of technology λ, the aggregate quality level of the rivals firms X_{-i} , additionally increases consumer's willingness to pay for firm *i*'s product.

Also, a typical downstream firm faces two types of variable cost, first, the input price *w*, charged by the upstream firms, second, the commission z_b, charged by the intermediary for every unit of input exchanged and third the cost of investment in output quality improvements, which is assumed to be quadratic, $C= x_i^2$. Concerning fixed costs, buyers have to pay an entry fee p_b, charged by the e-market owner. We assume negligible production cost and connection cost[22] for the downstream firms participating in the e-marketplace. As a result of the introduction of the product quality in the model, downstream firms compete not only in quantities (fourth stage) but also in the level of investment in product quality improvements (second stage).

As a consequence, the buyer's profit function is given by:

$$\Pi^b_i = - p_b + q_i (\alpha + x_i + \lambda X_{-i} - q_i - Q_{-i} - w - z_b) - x_i^2 \qquad (5.1)$$

All the upstream firms (suppliers) participating in the e-marketplace compete by adjusting their quantities simultaneously and independently (Cournot competition). Since there is one-to-one transformation of inputs to outputs, the total quantity of output (*Q*) is equal to the total quantity of input (*K*). Every supplier *j* ($j = 1, 2,..., n_s$) produces and sells a quantity of input k_j. It is assumed that a typical supplier faces one type of variable cost: the commission z_s for each unit of input sold. As in the buyers' case, suppliers also face one kind of fixed cost: the fixed entry fee p_s, for the

[22] The connection cost can be defined as the investment in new technology or/and the readjustment cost of business processes necessary for the buyers to be able to fulfill electronic transactions through a B2B e-marketplace.

participation in the e-market. In this way the profits of each upstream firm j, j=1,2,3,...,n_s, are given by:

$$\Pi^s_j = - p_s + k_j (w - z_s) \quad (5.2)$$

Finally, the intermediary extracts revenues by both suppliers and buyers, using entry (membership) fees (p_b, p_s) and commissions (z_b, z_s) for the quantity of input exchanged in the e-marketplace. Assuming negligible set up and maintenance cost for the operation of the e-market, the profit function for the intermediary is:

$$\Pi_I = p_b n_b + p_s n_s + K (z_b + z_s) \quad (5.3)$$

, where K is the total input quantity exchanged in the B2B e-marketplace and (z_b+ z_s) the sum of commissions charged to buyers and suppliers.

We consider a general four-stage game with the following sequence of strategic decisions:

- **Stage 1**: The intermediary sets the commission fees (z_b, z_s), as well as membership fees (p_b, p_s) for buyers and suppliers. These prices are public information and all downstream and upstream firms have perfect information about intermediary's decisions. In addition, firms enter in the e-market up to the point that their net profits are zero (free entrance condition or zero profit condition).
- **Stage 2**: All the downstream firms (buyers) compete in the downstream market by setting their level of quality upgrading investment simultaneously and independently.
- **Stage 3**: All the input suppliers compete in the upstream market by setting their quantities simultaneously and independently (Cournot competition).
- **Stage 4**: All the downstream firms compete in the downstream market by setting their quantities simultaneously and independently (Cournot competition)

The analysis of the fourth-stage game follows using the backward induction principal.

6. ANALYSIS

6.1 Strategic decisions for upstream and downstream firms

In the last stage of the game, a typical downstream firm (buyer), taking as given the aggregate output produced by its rivals in the B2B e-marketplace Q_{-i} , its output quality level x_i, the total quality improvements made by its rivals' investments X_{-i} , the extent of technology spillovers among downstream firms λ, the input price w, the commission z_b and the membership fee p_b charged by the intermediary, chooses its output quantity q_i in order to maximize its profits given in equation (5.1).

The first-order condition (f.o.c.) for buyer's profit maximization yields:

$$q_i^* = \frac{\alpha + x_i + \lambda X_{-i} - w - z_b}{1 + n_b} \tag{6.1}$$

, where it is assumed that α is large enough such that $\alpha \geq w + z_b - x_i - \lambda X_{-i}$. Due to symmetry, summing up the focs, the equilibrium aggregated output in the specific two-tier industry is:

$$Q = \frac{n_b(\alpha + x_i + \lambda X_{-i} - w - z_b)}{1 + n_b} \tag{6.2}$$

, and substituting equation (6.1) and equation $Q_{-i} = \sum_{j \neq i} q_i$ into equation (5.1), each downstream firm's profits are:

$$\Pi^{b}{}_i^* = -p_b + \frac{(\alpha + x_i + \lambda X_{-i} - w - z_b)^2}{(1 + n_b)^2} - x_i^2 \tag{6.3}$$

From the above expressions, it is obvious that firm i's output quality level x_i, the level of technology spillovers among downstream firms λ and the total output quality level of its rivals X_{-i} have a positive effect not only on the output price p_i but also on its output quantity q_i (= Q / n_b). In addition, firm i's profits are increasing in the level of technology spillovers λ and the total output quality level of its rivals X_{-i}. On the other

hand, firm i's output and profits are decreasing in the number of buyers n_b in the B2B e-marketplace, the input price w ,and the membership fee p_b and the commission z_b charged by the intermediary. Moreover, by inverting equation (6.2) we obtain input price w, as a function of total output Q:

$$w = \alpha + x_i + \lambda X_{-i} - \frac{Q(n_b + 1) + z_b n_b}{n_b} \tag{6.4}$$

In the third stage, all the upstream firms (suppliers) participating in e-marketplace compete by adjusting their quantities simultaneously and independently (Cournot competition). Because of the one-to-one transformation of inputs to outputs, the total quantity of the output (Q) is equal to the total quantity of the input (K)

$$K=Q \tag{6.5}$$

, and as a result equation (6.4) gives the inverse demand function faced by the suppliers. A typical supplier taking as given the aggregate input of its rivals K_{-j} and the input price w, chooses its quantity k_j in order to maximize its profits given in equation (5.2).

The f.o.c. in equation (5.2) shows that in a symmetric Cournot equilibrium, each supplier j produces a quantity:

$$k^*_j = \frac{n_b(\alpha + x_i + \lambda X_{-i} - z_b - z_s)}{(1 + n_b)(1 + n_s)} \tag{6.6}$$

, where it is assumed that α is large enough such that $\alpha > z_b + z_s - x_i - \lambda X_{-i}$. Equations (6.4) and (6.6) show that firm i's amount of investment for quality improvement activities x_i, its rivals' amount of investment X_{-i} and the level of technology spillovers λ among downstream firms have not only a positive direct effect on the output quantity and price (q_i / p_i) but also a positive indirect effect on the input quantity and price (k_j / w). Due to symmetry, the total quantity of input, as well as the total quantity of output (i.e. the total quantity exchanged on the e-marketplace), is equal to:

$$K(n_b, n_s, z_b, z_s, \lambda) = Q(n_b, n_s, z_b, z_s, \lambda) = \frac{n_b n_s (\alpha + x_i + \lambda X_{-i} - z_b - z_s)}{(1+n_b)(1+n_s)}, \qquad (6.7)$$

Equation (6.7) reveals that the total quantity exchanged on the B2B e-market increases with the number of suppliers and buyers (n_b / n_s), the amount of the downstream firm *i*'s investment for quality improvement activities x_i, the amount of its rivals' investment X_{-i} and the degree of technology spillovers λ, whereas it decreases with the commission fees charged by the intermediary (z_b / z_s). It is of course independent of the membership fees (p_b / p_s).

Substituting equation (6.7) into (6.4) and then into (6.3), we obtain downstream firms' profits:

$$\Pi^{b}{}_{i}{}^{*} = -p_b + \frac{n_s{}^2 (\alpha + x_i + \lambda X_{-i} - z_b - z_s)^2}{(1+n_b)^2 (1+n_s)^2} - x_i{}^2 \qquad (6.8.a)$$

Substituting equation (6.7) into (6.4) and then in combination with (6.6) into (5.2), we obtain upstream firms' profits:

$$\Pi^{s}{}_{j}{}^{*} = -p_s + \frac{n_b (\alpha + x_i + \lambda X_{-i} - z_b - z_s)^2}{(1+n_b)(1+n_s)^2} \qquad (6.8.b)$$

In the second stage, all the downstream firms participating in e-marketplace compete by adjusting their level of upgrading quality investment simultaneously and independently. Due to symmetry in the output quality level, the f.o.c. in equation (6.8.a) shows that each buyer i invest in quality improvement activities an amount equal to:

$$x_i{}^{*} = \frac{n_s{}^2 (\alpha - z_b - z_s)}{1 + 2n_s + n_b (2+n_b)(1+n_s)^2 - (n_b - 1)\lambda n_s{}^2} \qquad (6.9)$$

, where it is assumed that α is large enough such that $\alpha > z_b + z_s$. The denominator of the equation (6.9) is always positive.[23] Substituting equation (6.9) into (6.1) and (6.6) we obtain downstream firms' output quantity and upstream firms' input quantity:

[23] The denominator of the equation (6.9)

$$q_i^* = \frac{n_s\ (1+n_b)(1+n_s)(a-z_b-z_s)}{1+2n_s+n_b(2+n_b)(1+n_s)^2-(n_b-1)\lambda n_s^{\ 2}} \tag{6.10.a}$$

$$k_j^* = \frac{n_b(1+n_b)(1+n_s)(a-z_b-z_s)}{1+2n_s+n_b(2+n_b)(1+n_s)^2-(n_b-1)\lambda n_s^{\ 2}} \tag{6.10.b}$$

So, due to symmetry, the aggregate output/ input quantity is given by the following expression:

$$K(n_b,n_s,z_b,z_s,\lambda) = Q(n_b,n_s,z_b,z_s,\lambda) =$$

$$= \frac{n_b(1+n_b)n_s(1+n_s)(a-z_b-z_s)}{1+2n_s+n_b(2+n_b)(1+n_s)^2-(n_b-1)\lambda n_s^{\ 2}} \tag{6.11}$$

Additionally, substituting the above equations into the inverse demand functions faced by the buyers and the suppliers we obtain:

$$p_i = \frac{a(1+n_b)(1+n_s)(1+n_b+n_s)+ n_s[-n_s+n_b(1+n_b)(1+n_s)-(n_b-1)\lambda n_s](z_b+z_s)}{1+2n_s+n_b(2+n_b)(1+n_s)^2-(n_b-1)\lambda n_s^{\ 2}} \tag{6.12.a}$$

$$w = \frac{(1+n_b)^2(1+n_s)(a-z_b)+n_s z_s[1+n_b(2+n_b)(1+n_s)-(n_b-1)\lambda n_s]}{1+2n_s+n_b(2+n_b)(1+n_s)^2-(n_b-1)\lambda n_s^{\ 2}} \tag{6.12.b}$$

and finally the profits in both sides of the market at the equilibrium are:

$$\Pi^{b}{}_i^* = -p_b + \frac{n_s^{\ 2}[1+n_b(1+n_s)][1+n_b+n_s(2+n_b)](\alpha-z_b-z_s)^2}{[1+2n_s+n_b(2+n_b)(1+n_s)^2-(n_b-1)\lambda n_s^{\ 2}]^2} \tag{6.13.a}$$

$1+2n_s+n_b(2+n_b)(1+n_s)^2-(n_b-1)\lambda n_s^{\ 2} =$
$1+2n_s+n_b^{\ 2}(1+n_s)^2+2n_b+4n_b n_s+\lambda n_s^{\ 2}+n_b n_s^{\ 2}(2-\lambda) > 0$, where $0 \le \lambda \le 1$

$$\Pi^{s}{}_{j}{}^{*} = -p_s + \frac{n_b(1+n_b)^3(1+n_s)^2(a-z_b-z_s)^2}{[1+2n_s+n_b(2+n_b)(1+n_s)^2-(n_b-1)\lambda n_s{}^2]^2} \quad (6.13.b)$$

The above expressions (6.9)-(6.13) lead to the following propositions:

<u>Proposition 1</u>: *Due to technology spillovers among downstream firms, there is a positive direct network effect on downstream firms and a positive indirect network effect on upstream firms.*

Proof. The derivatives of functions (6.13) with respect to the level of technology spillovers among buyers λ documents:

a. The existence of positive direct effects in the downstream market due to technology spillovers among downstream firms[24].

$$\frac{\partial \Pi^{b}{}_{i}{}^{*}}{\partial \lambda} = \frac{2n_s{}^4[1+n_b(1+n_s)][1+n_b+n_s(2+n_b)](n_b-1)(a-z_b-z_s)^2}{[1+2n_s+n_b(2+n_b)(1+n_s)^2-(n_b-1)\lambda n_s{}^2]^3} > 0$$

b. The existence of positive indirect effects in the upstream market due to technology spillovers among downstream firms.

$$\frac{\partial \Pi^{s}{}_{j}{}^{*}}{\partial \lambda} = \frac{2n_b n_s{}^2(1+n_b)^3(1+n_s)^2(n_b-1)(a-z_b-z_s)^2}{[1+2n_s+n_b(2+n_b)(1+n_s)^2-(n_b-1)\lambda n_s{}^2]^3} > 0$$

<u>Proposition 2</u>: *The stronger the degree of technology spillovers among downstream firms, the higher the firms' upgrading quality investment.*

Proof. Equation (6.9) shows the positive effect of the level of technology spillovers among buyers *λ* on their amount of investment for quality improvement activities. The intuition behind this proposition is that as the level of technology spillovers among buyers λ increases each buyer's total upgrading quality level ($x_i + \lambda X_{-i}$) and profits ($\Pi^b{}_i$) increase too. As a result, each buyer separately, following a strategic behavior, has motivations to invest more in output quality improvements in order to increase its demand and possess a strategic advantage over its competitors.

[24] We assume that there are more than one buyers (n_b>1) in the electronic platform in order technology spillovers among buyers to exist.

Additionally, the above expressions (6.9)-(6.13) lead to the following lemmas. Lemmas 2 and 3 verify results of current economic research.

Lemma 1: *The degree of technology spillovers in downstream market has a positive direct effect on the output price, quantity and aggregate quantity and a positive indirect effect on the input price, quantity and aggregate quantity.*

Proof. The above proposition can be proved mathematically and theoretically. Mathematically, this can proved by equations (6.10) and (6.11) and differentiating (5.12) with respect to the degree of technology spillovers among buyers λ. The derivatives are positive[25]:

$$\frac{\partial p_i}{\partial \lambda} = \frac{n_s^{\ 2}(n_b^{\ 2}-1)(1+n_s)(1+n_b+n_s)(a-z_b-z_s)}{[1+2n_s+n_b(2+n_b)(1+n_s)^2-(n_b-1)\lambda n_s^{\ 2}]^2} > 0$$

$$\frac{\partial w}{\partial \lambda} = \frac{n_s^{\ 2}(n_b-1)(n_b+1)^2(1+n_s)(a-z_b-z_s)}{[1+2n_s+n_b(2+n_b)(1+n_s)^2-(n_b-1)\lambda n_s^{\ 2}]^2} > 0$$

Theoretically, as the level of technology spillovers among buyers increases each buyers' total upgrading quality level ($x_i + \lambda X_{-i}$) increases too, which in turn causes an increase in both output price, quantity and aggregate quantity and indirectly makes each supplier to set a higher input price and produce more input.

Lemma 2: *In both sides of the e-market, firms' profits increase in the number of firms of the other type (positive indirect network effects) and decrease in the number of firms of the same type (negative direct network effects).*

Proof. The derivatives of functions (6.13) with respect to the number of firms of the other type documents the existence of positive indirect network effects, since downstream firm's profit (upstream firm's profits) increases in the number of upstream (downstream) firms:

[25] We assume that there are more than one buyers (n_b>1) in the electronic platform in order technology spillovers among buyers to exist.

$$\frac{\partial \Pi^{b}{}_{i}{}^{*}}{\partial n_s} = \frac{2n_s(1+n_b)^2(1+n_s)[1+2n_s+n_b{}^2(1+n_s)^2 + 2n_b+4n_bn_s+n_bn_s{}^2t+n_s{}^2(2n_b-t)](a-z_b-z_s)^2}{[1+2n_s+n_b(2+n_b)(1+n_s)^2-(n_b-1)\lambda n_s{}^2]^3} > 0$$

or

$$\Pi^{b}{}_{i}{}^{*}(n_b,n_s,\lambda) < \Pi^{b}{}_{i}{}^{*}(n_b,n_s+1,\lambda)$$

On the other hand, firm's profit (e.g. supplier's profit) decreases as the number of firms of the same type (suppliers) increases, which reveals the existence of direct (or competition or negative) network effects:

$$\frac{\partial \Pi^{s}{}_{j}{}^{*}}{\partial n_s} = - \frac{2n_b(1+n_b)^3(1+n_s)[1+n_b{}^2(1+n_s)^2+2n_b+n_st(2+n_s) + n_bn_s(4-2t)+2n_bn_s{}^2(1-t)](a-z_b-z_s)^2}{[1+2n_s+n_b(2+n_b)(1+n_s)^2-(n_b-1)\lambda n_s{}^2]^3} < 0$$

or

$$\Pi^{s}{}_{j}{}^{*}(n_b,n_s,\lambda) > \Pi^{s}{}_{j}{}^{*}(n_b,n_s+1,\lambda)$$

Lemma 3: *The price allocation in commission fees charged by the intermediary does not affect the structure of the market.*

Proof. Equations (6.11) and (6.13) show that firms' profits as well as the quantity in the e-marketplace depend on the aggregate level on commission fees ($z_b + z_s$) and not on price allocation, i.e. the price level for z_b, z_s separately. This conclusion allows us to simplify the following analysis by expressing sum $z_b + z_s$ with the symbol z ($z = z_b + z_s$).

6.2 Strategic decisions for the intermediary

In the last stage of the game, the downstream and upstream firms enter in the B2B e-marketplace up to the point that their profits are zero (free entrance condition or zero profit condition). As a monopolist, offering the only transaction platform, the intermediary can extract all the surplus of participants in the B2B e-marketplace. This implies that the fees charged by the intermediary, both membership fees and

commissions could be such that the zero profit condition[26] is satisfied. This condition can determine either the number of upstream/downstream firms in equilibrium or, equivalently, the equilibrium value of the intermediary's strategic variable. In this analysis the second option is selected, i.e. the determination of maximum membership fees. Then the level of aggregate commission fee is determined through intermediary's profit function with a given number of buyers and suppliers (with exogenous variables n_b, n_s).

For buyers, the zero profit condition ($\Pi^{b}{}_{i}{}^{*} = 0$) leads to the following equation:

$$p_b(n_b, n_s, z, \lambda) = \frac{n_s{}^2[1 + n_b(1 + n_s)][1 + n_b + n_s(2 + n_b)](a - z)^2}{[1 + 2n_s + n_b(2 + n_b)(1 + n_s)^2 - (n_b - 1)\lambda n_s{}^2]^2} \tag{6.14}$$

In the same way, the zero profit condition for suppliers ($\Pi^{s}{}_{j}{}^{*} = 0$) leads to the following equation:

$$p_s(n_b, n_s, z, \lambda) = \frac{n_b(1 + n_b)^3(1 + n_s)^2(a - z)^2}{[1 + 2n_s + n_b(2 + n_b)(1 + n_s)^2 - (n_b - 1)\lambda n_s{}^2]^2} \tag{6.15}$$

As it can be easily checked, the above equations lead to the following lemmas:

Lemma 4: *The membership fees charged to both sides are always positive, which means that the intermediary never subsidizes the participation of any of the firms. This is due to the fact that there are no connection and production costs and the final products are not horizontally differentiated[27]. So*

$p^{*}{}_{b} > 0$ and $p^{*}{}_{s} > 0$

Lemma 5 :

a. *The membership fee that can be charged to one side of the market depends not only on the number of firms on this market-side, but also on the number of firms on*

[26] The zero profit condition is used when there is monopoly power in vertical relationships. Instead of zero profits the intermediary can allow both sides of the electronic platform to have profits equal to a constant positive price *l*. The analysis in the latter case leads to the same findings as in the zero profit condition setting.

[27] High values of connection and/or production costs and/or degree of product differentiation can lead to negative prices for p_b and p_s i.e. a kind of subsidy to one or both sides of the market (Kourgiantakis et.al. , 2007)

this market-side, but also on the number of firms on the other side (due to network effects).

***b**. There is a negative relation between the commission fee and the membership fee charged by the intermediary to the same market side.*

Then the intermediary maximizes its profits by selecting the price level for the commission fees for buyers and suppliers participating in the e-marketplace, taking as given the number of participating firms. The intermediary's profit function is given by the following equation:

$$\Pi_I = p_b(n_b, n_s, z, \lambda)n_b + p_s(n_b, n_s, z, \lambda)n_s + K(n_b, n_s, z, \lambda)z \qquad (6.16)$$

This profit function consists of two parts; the first refers to the revenues that the intermediary gains from the participation of firms in the B2B e-marketplace (participation revenues) and is expressed by the sum $p_b(n_b, n_s, z, \lambda)n_b + p_s(n_b, n_s, z, \lambda)n_s$ .The second part of eq.(6.16), i.e. $K(n_b, n_s, z, \lambda)z$, indicates the revenues from the commission fees (quantity revenues). This is so because every unit of the total quantity exchanged in the e-marketplace is charged with z_b and z_s, i.e. it is overall charged with z, by the intermediary.

Substituting equations (6.11), (6.14) and (6.15) into eq. (6.16) and applying first order conditions, the equilibrium aggregate price level for commission fees is given by:

$$z^* = \frac{a\{-1 + n_b^3(n_s - 1)(n_s + 1)^2 - n_b(n_s + 1)[3 + 2n_s(n_s + 2)] + n_b^2(n_s + 1)[-3 + n_s(-2 + n_s - \lambda n_s) + n_s[-3 + n_s(-4 + \lambda + \lambda n_s)]\}}{2n_s\langle - n_s + (n_s + 1)\{n_b[1 + n_b(n_b + 2)(n_s + 1)] - (n_b^2 - 1)\lambda n_s\}\rangle}$$

(6.17)

Equations (6.14), (6.15) and (6.17) lead to the following lemma:

<u>Lemma 6</u>: *The level of technology spillovers among downstream firms increases the membership fees and decreases the total commission charged by the intermediary.*

Proof. The positive relation between the membership fees and the level of technology spillovers is obvious from equations (6.14) and (6.15).Since there is a negative relation between membership fees and total commission fee (lemma 5.b) and the level of technology spillovers among buyers has a positive effect on membership fees, we automatically conclude that it has a negative effect on total commission fee. So the above result is expectable. Mathematically, the derivative of total commission fee with respect to the level of technology spillovers is negative:

$$\frac{\partial z}{\partial \lambda} = -\frac{\begin{array}{c}\alpha(n_b^{\ 2}-1)(1+n_s)[(1+n_b)^3+(1+n_b)^2(3+2n_b)n_s \\ +(1+n_b)^2(3+n_b)n_s^{\ 2}+n_b n_s^{\ 3}(2+n_b)]\end{array}}{2\left\langle n_s-(1+n_s)\{n_b[1+n_b(2+n_b)(1+n_s)]-(n_b^{\ 2}-1)\lambda n_s\}\ \right\rangle^2} < 0$$

In case that the number of participants in both sides of the market are given (i.e. n_b, n_s) and given the above equilibrium price for z, from equations (6.9), (6.11) and (6.14)-(6.16) the entry fees for suppliers and buyers, the intermediary's profits, the total quantity exchanged and the buyers' level of upgrading quality investment in equilibrium are:

$$p_b^{\ *} = \frac{a^2(1+n_b)^2(1+n_s)^2[1+n_b(1+n_s)][1+n_b+(2+n_b)n_s]}{4\left\langle n_s-(1+n_s)\{n_b[1+n_b(2+n_b)(1+n_s)]-(-1+n_b^{\ 2})\lambda n_s\}\right\rangle^2} \tag{6.18}$$

$$p_s^{\ *} = \frac{a^2 n_b(1+n_b)^5(1+n_s)^4}{4n_s^{\ 2}\left\langle n_s-(1+n_s)\{n_b[1+n_b(2+n_b)(1+n_s)]-(-1+n_b^{\ 2})\lambda n_s\}\right\rangle^2} \tag{6.19}$$

$$\Pi_1^{\ *} = \frac{a^2 n_b(1+n_b)^2(1+n_s)^2}{4\left\langle -n_s+(1+n_s)\{n_b[1+n_b(2+n_b)(1+n_s)]-(-1+n_b^{\ 2})\lambda n_s\}\right\rangle} \tag{6.20}$$

$$Q^* = \mathrm{K}^* = \frac{a\ n_b(1+n_b)^2(1+n_s)^2}{2\left\langle -n_s+(1+n_s)\{n_b[1+n_b(2+n_b)(1+n_s)]-(-1+n_b^{\ 2})\lambda n_s\}\right\rangle} \tag{6.21}$$

$$x_i^* = \frac{an_s(1+n_b)(1+n_s)}{2\left\langle -n_s + (1+n_s)\{n_b[1+n_b(2+n_b)(1+n_s)] - (-1+n_b^2)\lambda n_s\}\right\rangle} \tag{6.22}$$

Equation (6.20) shows that intermediary's profits are always positive.[28] $\Pi^{I*} > 0$

All the above equations allow us to establish the following propositions:

Proposition 3:

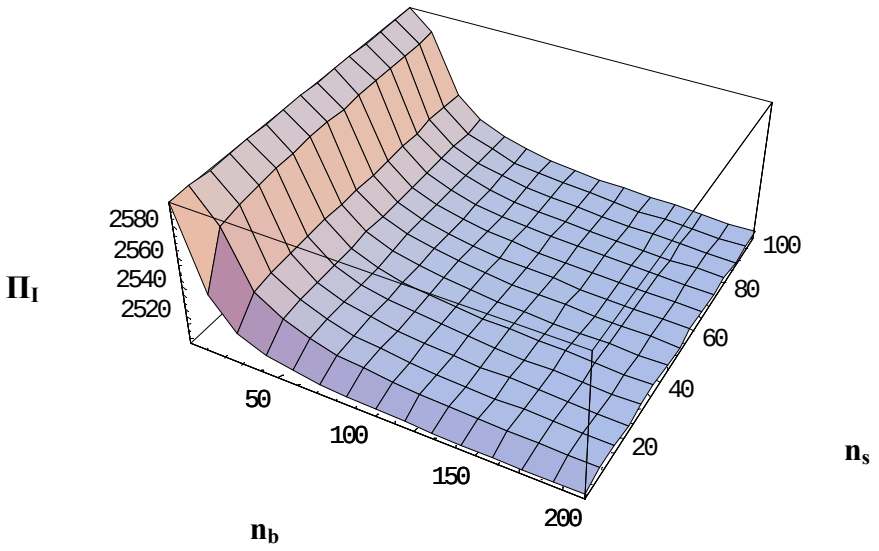
a. *The intermediary has strong motivations to create a B2B e-market place with high technology spillovers among buyers.*

Proof. The intermediary's profits increase with the degree of technology spillovers among buyers λ:

$$\frac{\partial \Pi_I^*}{\partial \lambda} = \frac{\alpha^2 n_b n_s (1+n_b)^2 (n_b^2 - 1)(1+n_s)^3}{4\left\langle -n_s + (1+n_s)\{n_b[1+n_b(2+n_b)(1+n_s)] - (-1+n_b^2)\lambda n_s\}\right\rangle^2} > 0$$

Additionally, we can represent the above result diagrammatically:

Intermediary's profits for λ=0,5



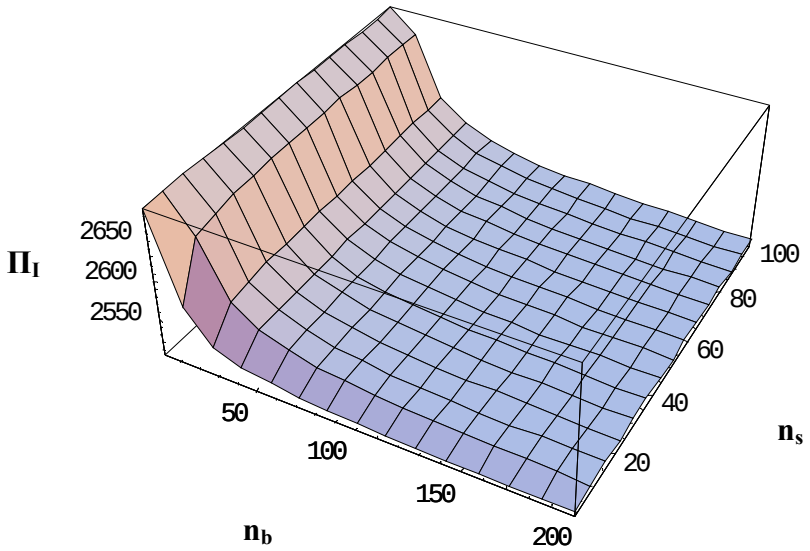
[28] The nominator of the equation (6.20) is positive and the denominator

$$4\left\langle -n_s + (1+n_s)\{n_b[1+n_b(2+n_b)(1+n_s)] - (-1+n_b^2)\lambda n_s\}\right\rangle =$$

$$4\left\langle n_s(n_b-1) + 2n_s n_b^2(1+n_s) + n_b^3[1+n_s(1-\lambda)] + \lambda n_b n_s + n_b[1+2n_b(1+n_s) + n_b^2 + n_b^2 n_s(1-\lambda) + \lambda n_s]\right\rangle$$

$$> 0,\ 0 \le \lambda \le 1$$

Intermediary's profits for λ=1



From the above diagrams, it is obvious that for λ=1 intermediary's profits are higher than for λ=0.5.

b. *Taking the number of suppliers and buyers as exogenously determined and assuming technology spillovers among buyers in e-marketplace (n_b > 1), the intermediary prefers to charge high membership fees and low commissions in e-marketplace, especially when the competition between buyers is weak.*

Proof. As it was proved the intermediary has strong incentives to create an e-marketplace with high technology spillovers. Hence, taking under consideration the positive relation between the level of technology spillovers and the membership fees and the negative relation between the level of technology spillovers and the total commission, we conclude that the intermediary's preferable pricing policy includes high membership fees and low total commission. Especially in cases that the number of downstream firms is low, the aggregate quantity exchanged in the e-marketplace Q is low and hence the intermediary obtains profits by charging a lower total commission for the decreased quantity and higher membership fees. This is obvious from the derivatives of membership fees and total commission with respect to the number of downstream firms:

$$\frac{\partial p_b^*}{\partial n_b} =$$

$$-\frac{\begin{array}{l} a^2(1+n_b)(1+n_s)^2{}'\{1+n_b(5+n_b)(1+n_s)^2+n_s)(1+n_s)(5+n_s) \\ +n_b^3(2+3n_s)(5+3n_s)+n_b^2(1+2n_s)(10+3n_s)+n_b(1+n_s)^2(5+13n_s)+ \\ [n_b^3n_s^2(2+3n_s)(5+3n_s)-\lambda n_bn_s^2(1+n_s)(4+n_s)]+[2n_b^3n_s(2+3n_b)(5+3n_s) \\ -2\lambda n_bn_s(1+n_s)]+[n_b^2n_s^2(1+2n_s)(10+3n_s)-\lambda n_s^2(1+n_s)(4+n_s)]+ \\ [2n_b^2n_s(1+2n_s)(10+3n_s)-2\lambda n_s(1+n_s)]+n_sn_b(1+n_s)^3(5-2\lambda) \\ +n_sn_b^2(1+n_s)^3(1-2\lambda) \end{array}}{2\left\langle -n_s+(1+n_s)\{n_b[1+n_b(2+n_b)(1+n_s)]-(n_b^2-1)\lambda n_s\}\right\rangle^3} < 0$$

or

$$p_b^*(n_b,n_s,\lambda) > p_b^*(n_b+1,n_s,\lambda)$$

$$\frac{\partial p_s^*}{\partial n_b} = -\frac{\begin{array}{l} a^2(1+n_b)^4(1+n_s)^4{}'[(2n_b^2-1)+n_s+7n_bn_s+n_b^3+2n_b^3n_s+2\lambda n_b^3n_s+ \\ n_b^2n_s(8-3\lambda)+n_b^2n_s^2(4-3\lambda)+2n_bn_s^2(n_b-\lambda)+2\lambda n_bn_s^2(n_b^2-1) \\ +n_bn_s^2(n_b^2-\lambda) \end{array}}{4n_s^2\left\langle -n_s+(1+n_s)\{n_b[1+n_b(2+n_b)(1+n_s)]-(n_b^2-1)\lambda n_s\}\right\rangle^3} < 0$$

or

$$p_s^*(n_b,n_s,\lambda) > p_s^*(n_b+1,n_s,\lambda)$$

and

$$\frac{\partial z^*}{\partial n_b} = -\frac{\begin{array}{l} a(1+n_s)[1+2n_b^3(1+n_s)^2(2+n_s)(1+2n_s)+4n_b+2n_bn_s(11-4\lambda)+ \\ 16n_bn_s^2(2-\lambda)+2n_bn_s^3(7-\lambda)+3n_s(2-\lambda)+8n_s^2(1-\lambda)+7n_s^3(n_b^2-\lambda) \\ +2n_s^4(2n_b^2-1)+2n_s^3+n_b^4(1+n_s)^2[1+n_s(2+n_s+\lambda)]+n_b^2(1-\lambda) \\ +2n_b^2n_s(15-7\lambda)+10n_b^2n_s^2(6-\lambda)+2n_b^2n_s^3(9-\lambda) \end{array}}{2n_s\left\langle n_s-(1+n_s)\{n_b[1+n_b(2+n_b)(1+n_s)]-(n_b^2-1)\lambda n_s\}\right\rangle^2} > 0$$

or

$$z^*(n_b,n_s,\lambda) < z^*(n_b+1,n_s,\lambda)$$

All the above can lead to a more general conclusion about the role of technology spillovers on the strategic behavior of all participating agents (buyers, supplier and intermediary) in a vertical B2B e-marketplace.

Corollary: The existence of high spillovers in vertical and independent B2B e-marketplaces boosts both buyers and suppliers and improves the intermediary's profits. As for the intermediary, it prefers to apply pricing policies with high membership fees and low commissions, especially in cases where the competition between downstream firms is weak.

The above table makes more obvious the positive effect of technology spillovers among buyers on the strategic decisions of all agents participating in the e-marketplace (buyers, suppliers and intermediary)

Table 5.2.1 Effects of technology spillovers among buyers on all agents' strategic behavior

Effect of λ	Variables	Effect
On buyers' strategic behavior	p_i, q_i, x_i, Q, Π^b_i	+
On suppliers' strategic behavior	w, k_j, K, Π^s_j	+
On intermediary' strategic behavior	p_b, p_s, Π_I	+
	z	–

6.3 Numerical examples for λ=0 and λ=1

For $\boldsymbol{\lambda}$**=0** (no technology spillovers among buyers) equations (6.20)-(6.22) are given by the following expressions:

$$\Pi_I^* = \frac{\alpha^2 n_b (1+n_b)^2 (1+n_s)^2}{4\{-n_s + n_b(1+n_s)[1+n_b(2+n_b)(1+n_s)]\}}$$

$$Q^* = K^* = \frac{\alpha n_b (1+n_b)^2 (1+n_s)^2}{2\{-n_s + n_b(1+n_s)[1+n_b(2+n_b)(1+n_s)]\}}$$

$$x_i^* = \frac{\alpha n_s (1+n_b)\ (1+n_s)}{2\{-n_s + n_b(1+n_s)[1+n_b(2+n_b)(1+n_s)]\}}$$

Setting n_b=50, n_s=100 and α=100, we obtain the following prices for the intermediary's profits, the total quantity exchanged and each buyer's total upgrading output quality level ($x_i + \lambda X_{-i}$):

Π_I^* = 2520

Q^* = 50

$R^* = (x_i + \lambda X_{-i}) = x_i$ = 0, 02

Similarly, for **λ=1** (full technology spillovers among buyers) equations (6.20)-(6.22) are given by the following expressions:

$$\Pi_I^* = \frac{\alpha^2 n_b (1+n_b)^2 (1+n_s)^2}{4[n_s^2 + n_b(1+n_s) + n_b^3(1+n_s)^2 + n_b^2(1+n_s)(2+n_s)]}$$

$$Q^* = K^* = \frac{\alpha n_b (1+n_b)^2 (1+n_s)^2}{2[n_s^2 + n_b(1+n_s) + n_b^3(1+n_s)^2 + n_b^2(1+n_s)(2+n_s)]}$$

$$x_i^* = \frac{\alpha n_s (1+n_b)(1+n_s)}{2[n_s^2 + n_b(1+n_s) + n_b^3(1+n_s)^2 + n_b^2(1+n_s)(2+n_s)]}$$

and setting n_b=50, n_s=100 and α=100, we obtain the following prices:

Π_I^* = 2549,5

Q^* = 51

$R^* = (x_i + \lambda X_{-i})$ = 1

Comparing above numerical results for λ=0 and λ=1, it is obvious that full spillovers among downstream firms improve the intermediary's profits and increase both the aggregate quantity exchanged in the electronic platform and each downstream firm's aggregate output quality level.

7. SOCIAL WELFARE ANALYSIS

In this section we focus on the social welfare analysis and more specifically we study the preferences of a social planner (or regulator) in the pricing policy of the intermediary in the electronic platform. Due to the fact that the literature of the electronic commerce upon the welfare analysis is extremely limited, the conclusive points that arise in this section can be considered to be robust, even if they are general.

First of all, we suppose that there is one regulator, which approves the creation of a vertical electronic market for the transactions of the two-tier industry under consideration and additionally searches for the appropriate pricing policy of the intermediary, which will enforce the social welfare. In our setting, the appropriate measure of social welfare consists of two parts: consumer's surplus, which is given by the expression $(1+\gamma)\ Q^2 / 4$, where γ is the level of the outputs differentiation ($0 \leq \gamma \leq 1$) , and the intermediary's profits Π^I. In this model we suppose that the final products which are produced by the downstream firms that join the electronic platform are homogenous and as a result $\gamma=1$. So, in this case the social welfare is given by the following expression:

$$W = \frac{Q^2}{2} + \Pi_I \tag{7.1}$$

Not to mention that the profits of both downstream and upstream firms are zero due to free entrance condition and in consequence the intermediary's profits constitute the sole profits in the two-tier industry under consideration and thereby the sole profits' effect on the social welfare.

Substituting equations (6.11) and (6.16) into equation (7.1) and applying first order conditions, the level aggregate commissions (z) that maximizes the social welfare is given by the expression:

$$z^W = -\frac{\begin{array}{c}\alpha\{1+n_b{}^3(1+n_s)^2+n_b(1+n_s)[3+n_s(5+3n_s)]+n_b{}^2(1+n_s)\\ [3+n_s(4+n_s+\lambda n_s)]+n_s[3-n_s(-4+\lambda+\lambda n_s)]\}\end{array}}{n_s\left\langle\ -2n_s+(1+n_s)\{n_b[1-n_s+n_b(2+n_b)(1+n_s)]-2(-1+n_b{}^2)\lambda n_s\}\ \right\rangle} \tag{7.2}$$

From the above expression, the total commission (z^W) that maximizes the social welfare turns out to be negative. [29]

$z^W < 0$

This can be interpreted by the fact that the social regulator prefers the intermediary subsidize the input quantity exchanged in the B2B e-marketplace, increasing by this way the aggregate input/ output quantity (*K/Q*) in the two-tier industry and in turn the consumer surplus ($Q^2/2$). As it arises, the fact that the optimal total commission (z^W) is negative implies how important the consumer surplus is for the social planner.

Also, substituting equation (7.2) into equations (6.12) and (6.13), we can get the the membership fees charged to downstream and upstream firms, which maximize the social welfare W^*:

$$p_b^{\ W} = \frac{a^2(1+n_b)^2(1+n_s)^2[1+n_b(1+n_b)][1+n_b+n_s(2+n_b)]}{\left\langle -2n_s+(1+n_s)\{(n_b[1-n_s+n_b(2+n_b)(1+n_s)]-2(-1+n_b^{\ 2})\lambda n_s\}\right\rangle^2} > 0 \quad (7.3)$$

$$p_s^{\ W} = \frac{a^2 n_b(1+n_b)^5(1+n_s)^4}{n_s^{\ 2}\left\langle -2n_s+(1+n_s)\{(n_b[1-n_s+n_b(2+n_b)(1+n_s)]-2(-1+n_b^{\ 2})\lambda n_s\}\right\rangle^2} > 0 \quad (7.4)$$

One question that arises is: which is the effect of this pricing policy on the intermediary' profits, as the total commission decreases ($z^W < z^*$)? Initially it is easily proved that the optimal for the social planner membership fees are always higher than the optimal for the intermediary membership fees ($p_b^W > p_b^*$ and $p_s^W > p_s^*$). This finding is predictable because of the negative relationship between the membership fees and the total commission per unit of quantity exchanged in the electronic

[29] The nominator of the equation (7.2) is equal to

$$= a\{1+n_b^{\ 3}(1+n_s)^2+n_b(1+n_s)[3+n_s(5+3n_s)]+n_b^{\ 2}[3+n_s(4+n_s+\lambda n_s)]+n_b^{\ 2}n_s(3+\lambda n_s^{\ 2})$$
$$+n_s(3+4n_s)+n_s^{\ 2}(4n_b^{\ 2}-\lambda)+n_s^{\ 3}(n_b^{\ 2}-\lambda)\} > 0$$

and the denominator of the equation (7.2) is equal to

$$n_s\left\langle \begin{array}{l} 2n_s(n_b^{\ 2}-1)+2(1+n_s)n_b^{\ 2}n_s(n_b-\lambda)+(1+n_s)n_b\{[1+n_s(n_b^{\ 2}-1)+n_b^{\ 2}]+2\lambda n_s\} \\ +2n_b^{\ 2} \end{array}\right\rangle > 0$$

, $0 \le \lambda \le 1$

platform (when $z^W < z^*$, $p_b^W > p_b^*$ and $p_s^W > p_s^*$ holds). Substituting the equations (7.2)-(7.4) into the equation (6.16), the profits of the intermediary according to the optimal policy of the social planner have the following expression:

$$\Pi_I^W = -\frac{\alpha^2 n_b n_s (1+n_b)^2 (1+n_s)^2 [1+n_b(1+n_s)+(n_b^2-1)(1+n_s)\lambda]}{\left\langle -2n_s+(1+n_s)\{n_b[1-n_s+n_b(2+n_b)(1+n_s)]-2(-1+n_b^2)n_s\lambda \right\rangle^2} < 0,$$

and they are always negative $\forall n_s > 0$, $n_b > 1$ and $0 \leq \lambda \leq 1$, unlike the profits of the intermediary according to its own optimal policy, which are always positive ($\Pi_I^* > 0$). So, $\Pi_I^W < \Pi_I^*$.

All the above indicate that under regulator's optimal policy, the increase in the consumer surplus counterbalance the intermediary's profits loss and leads to an increase in the social welfare. Besides, this finding shows that the social planner has to subsidize the intermediary in order to make it apply a pricing policy that maximizes the social welfare. The subsidization level must be equal to the difference between the intermediary's profits with and without the intermediary's intervention ($\Pi_I^* - \Pi_I^W$)

8. CONCLUDING REMARKS

The aim of the present thesis was to model vertical and independent B2B e-marketplaces in a framework, incorporating technology spillovers among downstream firms. Technology spillovers were found to be crucial for the strategic behavior of all agents participating in a vertical and independent B2B e-marketplace (downstream firms, upstream firms and intermediary). In particular, our analysis reveals that high technology spillovers improve profits of all agents. As a result the intermediary has strong motivations to create an electronic platform with high technology spillovers. Additionally, it was found that the intermediary is benefited most from pricing strategies with high membership fees and low commissions especially in cases that there is a weak competition between downstream firms in the e-marketplace.

We are aware that the undertaken analysis has several limitations and could be extended towards various directions. In future work it would be valuable to make some changes in our model by assuming differentiated final products instead of homogenous or incorporating connection and production costs. Also it would be of great interest to investigate the effects of technology spillovers in cases where two or more intermediaries compete with each other in both single-homing and multi-homing pattern or in cases where the intermediary can define the number of firms in the e-market (the number of firms endogenously determined).

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