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Cultural Industries and Innovation-An Empirical Analysis

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ABSTRACT

The multitude of research work on Creative industries speaks to the importance of this sector of the knowledge-based economy. Creative industries worldwide have witnessed rapid growth in the past decade and this has prompted more interest in this sector. Research on innovation in creative industries on the other hand has been rather limited, although several studies have indicated useful approaches to the management and organization of innovation relevant to the creative industries, however empirical studies in this respect are still far from comprehensive, hence prompting this empirical research on the impact of innovation on productivity in Creative Industries with a focal point on China Online Game Industry.

This paper empirically studies the links between innovation and productivity at the firm level in Creative Industries using Chinese Online Game Industry as the focal point of its analysis. This paper bases its analysis on the recommendations of the Oslo Manual, this approach provides a way to achieve a high level of comparability within the Industry, it also provides standard definitions and indicators of innovation. The paper went further to adopt the scoring matrix approach in order to capture and delineate the various dimensions, dynamics and key features of online gaming enterprises in China. Indicators adopted in the analysis were selected based on literature review and statistical analysis.

The empirical approach is based on data obtained from enterprise-based surveys of innovative activity in Chinese online game firms. The paper applied an econometric model of Research and Development, innovation and productivity interrelations at a firm level similar to that of Crépon, Duguet, and Mairesse (1998) for France, to the micro data obtained for China online gaming industry.

Keywords: Culture Industry, Creative Industries, Creativity, Innovation, Online Games, and Knowledge Production Function.

INNOVATION AND KNOWLEDGE MANAGEMENT

Innovation in creative industries often occurs when those producing creative content respond to the experiences of consumers and users, and make changes to their offer as a result (Miles and Green, 2008).

This paper researches the various aspects of innovation and knowledge management and their impact on productivity at a firm level in creative industries with a focal point on Chinese Online Game Industry. This empirical study enhances the understanding of innovation in firms using data obtained from enterprise based innovation survey in addition to complementary data from various statistical data sets. In the course of analysis this dissertation also raised questions for future research in this field as well as making recommendations to mitigate extant obstacles identified in the course of research. Contrary to long-established analysis that only utilize traditional innovation indicators mainly designed for manufacturing industries, this dissertation applies economic innovation theory to cultural economics, using indicators that better capture the dimensions and dynamics of innovation and creativity in creative industries. Traditional innovation metrics are hardly sufficient to neither capture nor measure innovation performance in the creative industries, hence the need to define a new set of indicators and enhance existing ones. Griliches in 1979 proposed a framework for the analysis of innovation and productivity growth. This framework was presented in the form of a flowchart that depicted the path through which investment in Research and Development activities generated knowledge and the outputs and indicators of knowledge. Crépon, Duguet and Mairesse (1998) enhanced Griliches' framework by proposing an encompassing model that enhanced the understanding of the channels linking investment in knowledge to productivity growth. The Crépon Duguet and Mairesse (1998), elaboration of the Griliches framework detailed measurable quantities and unquantifiable concepts, which had crude proxies. This paper uses an extended model of the Crépon, Duguet and Mairesse model, which is a structural model, made up of three stages of recursive equations. The first stage comprises of innovation input equations. These equations explain a firms' decision to engage in innovation activities and innovation expenditure intensity. For a given probability to innovate, the second equation of the first stage models an innovation expenditure equation. The dependent variable for the second equation is the logarithm of innovation expenditure per employee.

The second stage comprises of innovation output equations. These equations deal with product innovation output intensity and process innovation output. It models the knowledge production function. The final stage is made up of the productivity equation, which explains the impact of innovation output on productivity. It estimates the innovation output productivity link using an enhanced Cobb-Douglas production function.

CREATIVE INDUSTRIES

Creative industries are those activities, which have their origin in individual creativity, skill and talent, and have the potential for wealth creation through the generation and exploitation of intellectual property (DCMS, 1998). Although creativity is not an absolute distinguishing characteristic of creative industries, it is however a core concept of such industries.

It is noteworthy that the dynamic nature of the creative industries is heavily reliant on constant innovation. The terms innovation and creativity are intertwined but not interchangeable, hence they both relate to the same core concept of new creations and originality. Innovation is accepted as the prerequisite for change (technological), ergo it is the foundation of long-term economic growth (cf. Edquist 1997:1/Freeman 1997:316/Fischer 2001:200).

Creative industry on a cursory analysis might seem to be an extrapolation of the cultural industries, however on a closer more critical analysis, the differences between both paradigms become evident. The concept of creative industries originated in Australia in the early 1990s, but it received a wider acclaim and development in the UK in the late 1990s when the Department for Culture, Media and Sport (henceforth DCMS) established its Creative Industries Unit and Task Force. Although there are obvious similarities between cultural industries and creative industries, however the new concept represents a significant shift in approach to potential commercial activities that until then were regarded mainly in non-economic terms. The DCMS further transformed the understanding of the concept, thus bringing about a shift in the view creative industries as industries that are creation-intensive and heavily dependent on intellectual property as opposed to the common association with activities with a strong artistic component that was central to cultural industries.

In the creative industries, culture and economics are juxtaposed. To emphasize this point, UNCTAD (2010) states "…. the creative industries sector lies at the crossroads between the arts, business and technology. A strong, mutually reinforcing relationship exists between and among the different artistic and economically distinct activities that make up the cluster of creative industries, ranging from upstream activities, such as the traditional arts, performing arts, literature and visual arts, to downstream activities such as advertising, design, publishing and media-related activities. The latter applied much closer to the market than the commercial application of traditional cultural activities. Downstream activities derive they commercial value from low reproduction costs and easy transfer to other economic domains. From this perspective, cultural industries make up a subset of the creative industries, while the even broader cluster copyright industries consist of both creative industries and distribution-based industries" (UNCTAD, 2010).

The concept of creative industries is ginormous and it encompasses a vast number of creative sectors, which range from activities rooted in traditional knowledge and cultural heritage such as art crafts, and cultural festivities, to technology intensive and service-oriented subgroups such as audiovisuals and the new media. These sectors are generally lumped together under the "creative industries" umbrella by most nations and organizations without proper classification into domains, groups or categories, this phenomena has caused the process of understanding of the cross-sectoral dynamics to be fraught with error, therefore arousing the need for a standardization in the form of classification to provide clarity and consistency in quantitative and qualitative analysis.

INNOVATION

Innovation is a universal paradigm that deals with novelty, creativity, economic contribution and diffusion of inventions. Innovation can be defined as the application of new idea to the products, processes, or other aspects of the activities that lead to increased "value". This "value" is defined in a broad way to include higher value added for the firm and also benefits to the consumers or other firms (Greenhalgh and Rogers, 2010). The litany of research work done in this field of study has resulted in a fuzziness with regard to innovation related semantics and concepts. This confusion extends into the taxonomy of innovation. Knowledge research and innovation are of crucial importance for the competitiveness of the modern economy, as well as for high standards of living and welfare (Bloch and Bassols, 2009). Professor Schumpeter identified innovation as a driver of economic development/growth.

Contemporary Innovation Theory

Innovation has become a ubiquitous term (Slade and Bauen, 2009). Innovation refers to an iterative process of inventions and applications that links technical, societal and political change (Green et al., 2009). Innovation classification depends on its origin, nature and effect. It can be classified as incremental, radical, or disruptive, depending upon whether it originates within, or outside, the mainstream, and whether it renders an incumbent technology (or process) obsolete (Green et al., 2009). The roots of innovation theory are multidisciplinary (Gross, 2010).

"Innovation is a broad concept which encompasses a wide ridge of activities and processes, markets, entrepreneurship, networks and competition, but also skills and organizations, creativity and knowledge transfers (OECD, 2009)".

Based on innovation definitions in the third edition of the Oslo manual (OECD/Eurostat, 2005) innovation can be divided into product innovation Process innovation, marketing innovation and organizational innovation…. "Innovation is the implementation of a new product (good or service), or process, a new marketing method, or a new organizational method in business practices,

workplace organization or external relations (OECD, 2005)".Product innovation: This form of innovation refers to the launch of a completely new product or service or a remarkably augmented version that differs from similar existing products in both characteristics and usage.

Process innovation: As previously noted, process innovation dwells on the induction of new or ameliorated methods or principles applied to reform and enhance both production and delivery processes. The reforms can be in form of equipment, software or techniques upgrade.

Market innovation: This form of innovation involves the application of new marketing concepts, involving changes in product design or packaging, product placement, product promotion or pricing. It could also include discovering new markets for extant products.Organizational innovation**:** This form of innovation refers to the adoption of nouveau organizational methods in the enterprises' business practices, workplace organization or external relations.

Innovation can be further defined as the application of new ideas to products, processes, or other aspects of the activities of a firm that lead to an increased value. The importance of innovation cannot be overemphasized.… "Not to innovate is to die" wrote Christopher Freeman (1982) in his famous study of the economics of innovation, this further stresses the need for innovation in economies and enterprises alike. Corporations need to be able to innovate (i.e. adapt and evolve) if they wish to survive their competitors. J. Schumpeter postulated that anyone/corporation that seeks profits must innovate. It is therefore evident that innovation is both significant and widely accepted to be a prerequisite for economic development.

The innovation paradigm is so ubiquitous that it verges on becoming a cliché. A review of books published in the United States between 1994 and 1995 reveal that 275 books had the term 'innovation' in their title (Coyne, 1996). The massive use of the term has led to an ambiguity as to how it is comprehended, coupled with the fact that innovation has been a topic for discussion and debate for hundreds of years. It is therefore vital to review innovation in the light of extant literature and track the development and transitions in both innovation semantics and concepts.

REVIEW OF EXTANT LITERATURE

Schumpeter (1934,1939,1942) as prior stated was one of the pioneers of the idea that innovation was critical to economic growth/development. He stated that economies would experience growth due to the development of new products. In summation Schumpeter stated that the competition created by new products was far more valuable than marginal changes in the prices of existing products. Economic development however does not occur in a regular well-defined fashion; instead it occurs in 'bursts' or waves of activity, thereby signaling the important effect of external forces on it. One of such external factors is innovation. Marx made the proposition that innovation could be associated with waves of economic growth. With this proposition in the backdrop, Schumpeter (1934,1939), Kondratieff (1935/51), Abernathy and Utterback (1978) have argued the long-wave theory of innovation. Abernathy and Utterback (1978) postulated that at the commencement of any industrial sector there will be a radical product innovation, which is then sequenced, by radical innovation in production processes, sequenced again by widespread incremental innovation. This postulation received wide acclaim, however it failed to offer any understanding of how to achieve innovative success.

Since it has been determined that innovation is one of the external factors that influences economic growth, it is then necessary to understand what factors that influence innovation. Schumpeter postulated that modern firms equipped with R&D laboratories have become the central innovative actors, thereby identifying R&D as a factor that has critical influence on innovation. However spending on R&D does not have a direct correlation with economic growth, thereby suggesting a more complex linkage with innovation. Further advancement revealed that external sources of knowledge also have significant influence on innovation process, irrespective of the organizational level at which the innovating unit is situated. The instance of Japan illustrates the issue explicitly at the national level (Westney and Sakakibara, 1986; Rosenberg and Sternmuller, 1988;Mansfield, 1988). In the aftermath of the Schumpeterian postulation, other economists made significant contributions to the innovation debate (Chandler, 1962;Nelson and Winter, 1982;Cohen and Leviathan, 1990;Prahalad and Hamel, 1990;Pavitt, 1990;Patel and Pavitt, 2000).Brock (1975) proposed that the Schumpeterian postulation holds true for various industries, for example the computer industry and also in the case of the aluminum industry (Deck, 1962).March and Simon (1958:188) implied that most innovations ensued from borrowing instead of invention. Research on the sources of innovation lent credence to their observation (Muller, 1962; Hamberg, 1963;Myers and Marquis, 1969;Johnston and Gibbons, 1975; von Hippel, 1988).

Although external sources of information/knowledge are of an important nature to the process of innovation, so also is the information emanating from internal units of the firm (Mansfield, 1968). Theoretical research on innovation in 1950s and 1960s widened the perspectives on the sources of innovation. The research during this period pivoted on the promotion of innovation in organizations through effective management of R&D departments and their activities (Xu, 2007). Further research on innovation shed light on the macro-economic importance of innovation investigating the relative significance of different factors to the growth of national economies (Solow, 1957). Solow proposed that the largest contribution to growth was from increases in technical

change as opposed to increases in labor or capital productivity. Solow further postulated that increase in technical change counted for approximately 40% of the total increase in US national income per head.

CREATIVE INDUSTRIES AND INNOVATION

Innovation theory is a well-researched field of economics, however the study of innovation in creative industries is a rather new and evolving academic effort (Brandellero, Kloosterman, 2010; Green et al., 2007). The number of academic studies on innovation in creative industries is so limited that it has a direct impact on the degree to which the mechanism and dynamics of innovations in the said industries is understood. Australian report QUT CIRAC & Company (2003:6) stated, "the nature of research and development within the creative and content industries generally has not been closely examined". The report went further to state "these industries have tended to be at the fringes of national discussions about science and innovation policy, and of related funding and industry programs".

The role and potential of research and development to support the creative industries has also been an issue of discussion. A research carried out by the Foundation for Research, Science and Technology (2003) in New Zealand with the aim of addressing this issue reported: " R&D was more often seen as a means of reducing costs, rather than a means of improving products in order to enter new markets (…) Establishing a creative industries consortium (a formal public-private partnership) would therefore be the most effective means to consolidate focused research effort over the long term" (Foundation for Research, Science and Technology,2003:12&22). Potts (2009:141) was of the opinion that " R&D has a different meaning in creative industries…. in effect constituting a normal business model, not an exceptional (i.e. un-incentivized) activity". This opinion which does not adequately address the issue of R&D in creative industries, is however quite similar to that provided in the Basin report (Basin, 2013:12) which equates "creation /production rights" with R&D. R&D is an input to the innovation process, it is not an output, hence it is rather pointless equating R&D to creation. The distinguishing element between innovation and creation lies in the nature of knowledge involved, tacit or otherwise (Barrera and Santayana quoted by Paris, 2014), thus such a difference would have an impact on the industrial structure and business model of the enterprises.

Yet another point of view on innovation in the creative industries which was previously unknown was brought to light by Green et al (2007:58). They proposed the concept of the 'hidden' character of innovation in the creative industries. They stated, " the creative sectors are under-represented in innovation and R&D surveys. These surveys tend not to sample the small establishments and self-employed individuals that are common features of these industries". Consequently majorities of creative industry innovation go unnoticed or under-reported in statistical accounts of innovation in the knowledge-based economy and innovation survey statistics. Green et al went further to describe these types of innovation as "hidden" by virtue of being distinctive when compared with those traditionally studied. Innovation metrics were designed primarily for manufacturing industries, equipped with indicators designed to capture innovation performance in such industries, it is difficult to adapt these indicators to efficiently capture/identify innovation in creative industries. Another causative factor of hidden innovation is the fact that most innovation might be hidden because they vary from the originally identified innovation. Several innovations in the creative industry are spontaneous, on-the-job and usually one-time innovations, making it inherently difficult to replicate and record, hence leading to hidden innovations. NESTA (2007) identified four different types of hidden innovation, namely:

1) "Innovation that is the same or similar to activities that are measured by traditional indicators, but which is excluded from measurement;

2) Innovation without a major scientific /technological basis, such as innovation in organizational forms or business models,

3) Innovation created from the novel combination of existing technologies and processes, and,

4) Locally-developed, small scale innovations that take place 'under the radar' and are therefore unrecognized or accounted for".

Regarding the degree of 'hidden innovation' Miles and Green (2008) stated: "the scale of hidden innovation in the creative industries seems to be great and the forms it takes appears to be extraordinarily diverse".
Stoneman (2007) put forward the notion of 'soft innovation', which he distinguished into innovation in products and innovations in industries. Subsequently Jisun (2010) postulated that creative products are mostly reliant on non-technological 'soft' innovations (Stoneman, 2007) connected to the creation of new ideas or a novel combination of extant ideas. T.Paris was of the opinion that creative dynamism is a consequence of the interactions between 'soft' and 'hard' innovations.
Several studies have attempted to address the question of why creative industries require a distinct internal account of its own organizational and industrial innovation processes. Prominent among these studies are Castner and Campos (2002), who relied on the theory of organizational innovation to examine the role of micro and organizational variables in the process of artistic innovation. Handke (2006,2007) sought to identify the factors driving innovation in the media industries by analyzing innovation surveys. Tether (2003) followed in Handke's line of research, however he sought to compare innovation performance with other sectors. These afore listed research works have generally shaped the industrial/national framework of the research in innovation in

creative industries. Major instances include, Green et al (2007) who investigated product design and video games in the UK, Stam et al (2008:125-126), who researched innovation in media and publishing in the Netherlands, Eltham (2009:235) who focused on Australia and Cunningham et al (2004:4) and QUT CIRAC Cutler and Company (2003:29) who stated that " the many different research fields involved with creative industries do not relate to each other well and the potential linkages are seldom articulated into an R&D strategy involving the linkages between ICT ,creative content , and educational services industry content". Muller et al (2009:2008:2) researched creative enterprises in Austria. They postulated " creative industries are intensive users of technology and often deemed adaptions and new developments of technology, providing innovation impulses to technology producers".

ONLINE GAMING

Online gaming is an integral component-industry of the creative industries. This sector of the knowledge-based economy has witnessed an exponential growth since its inception. Further growth has occurred as a result of technological advancements. Advancements in technology keeps increasing and redefining computational power and introducing new platforms adaptable to online gaming. Factors responsible for this exponential growth will be addressed in a later section.

Global and regional growth of this sector has been both explosive and sustained. The growth of online games (also referred to as video games in the US) in the United States has been quite tremendous. In 1999, the online game industries net revenue was a mere $7.4 billion, in 2002;it jumped to $13 billion (PC Data, 2000;Graser, 2000;Gaudios, 2001). China and Korea are leading examples of nations that have experienced rapid and sustained growth in the online gaming industry. In 2014 the revenue from the China Online Gaming Industry was 110.81 billion Yuan, exceeding the 100 billion Yuan mark. China online games revenue reached a peak value of 32.08 billion Yuan in the first quarter of 2015;marking the first time that revenue from the industry ever crossed the 30 billion Yuan milestone. This represents an 8.0% quarter-on-quarter growth, as well as a 24.7% year-on-year growth (iresearch.com). The above stated revenues include the revenue of PC client games, PC browser games, as well as mobile games. Mobile games revenue made up 31% of the revenue in the first quarter of 2015. The revenue also encompasses the total spending of online game players in Chinese mainland and the total revenue of China online game enterprises gained from overseas markets.

Evolution and Development of Online Gaming in China

At the outset of the development of online gaming in China, China was situated at the lowest level of the industry value chain. During that period, China served a 'middleman', procuring international game licenses for localization and hosting on the Mainland (Chung &Yuan, 2009;Ernknst & Ström, 2008; Ron & Hardwick, 2009). Its primary sources of online games were Korea and western countries. However with increased technical ability and strong innovation systems, China gained competitiveness in this sector, experiencing astronomical growth and expansions. This sustained growth and development resulted in China outperforming Korea in market size in 2006. The online game market size in China was valued at $788 million at the time. The market size grew to 83.17 billion RMB ($13.4 billion) in 2013. In 2014 PC-based online games earned a revenue of 53.66 billion RMB , with browser-based games ranking second with a revenue of 12.77billion RMB , mobile games ranked third with a revenue of 11.29 billion RMB ,social networking games followed with a revenue of 5.41 billion RMB, and single player games ranked last ,with a revenue of 0.9billion RMB (GPC,2004).

The development and spread of broadband technology stimulated a growth in the number of internet users, which in turn led a significant increase of online gamers, which further stimulated growth in this sector. According to CNNIC, China's Internet population in 2003 was only 80 million, however by the end of 2013, China had 618 million Internet users. CNNIC (2014) stated, that an estimated 338 million Internet users had access to online games via personal computers, while 225 million users had similar access via mobile phones.

The rapid development of the online gaming sector has transformed the role of China from that of a mere importer and distributor of foreign games, to that of a developer and exporter. Various factors have contributed to the immense growth of the online gaming sector in China. Prominent among these factors are the following:

Increased development and operational service competence: As previously stated, China made its debut in the world of online gaming at the lowest level of the industry value chain. The prevalence of piracy and strict governmental policies prevented foreign gaming giants to make inroads to China. This vacuum thus provided an environment suitable for development for Chinese online game companies. These companies who were previously engaged only in licensing and joint ventures with foreign companies, utilized the vacuum to enhance development capabilities. Considering the fact that online games are services, Chinese companies also enhanced their operational service capabilities, adopting and developing business models based on local preference. They utilized their knowledge of the local market as a competitive advantage. The direct consequence of this developmental process is evident in the plethora of domestically developed games in both foreign and local markets. Most companies even developed proprietary game engines. Although their development and operational capabilities has increased exponentially, Chinese companies still lag behind their international counterparts in terms of advanced gaming technology and capabilities. Based on the development trajectory of this industry, it is forecasted that Chinese companies will attain or exceed the capabilities of their foreign counterparts in the near future.

Consumers' propensity to play games: As of June 2014, China had 632 million Internet users, which was an increase of 14.42 million over the past half year (CNNIC). The surge in numbers of Internet users translated to a similar surge in online gamers. Internet users aged between 20-29 years accounted for 30.7% of the total. The number of online gamers reached 368 as of June 2014. Online gaming has a huge appeal to youths (Ewing, 2007). From statistical analysis, it is easily evident that the development of the online games industry is linked to and stimulated by the high proportion of young gamers. Chinese youth affinity to mobile technology has also accelerated growth in the online game sector. By the end of June 2014, the number of mobile game online users reached 252 million, with utilization ratio growing from 43.1% at the end of 2013 to 47.8%, with an increase of 36.48million (CNNIC, 2014). This growth in the number of gamers has a positive correlation to development of the online game industry in China.

Development of games to conform to local tastes and preferences: McKinsey Quarterly (2006) article stated: "Consumers in China (….) have strong national pride, so multinational companies could lose important segments by seeming too foreign". Research has illustrated that the level of Chinese characteristics in online technology and products co-varies positively with Chinese consumers' likelihood of doing business with a company. This sentiment applies succinctly to the online game industry. The cultural difference between the East and the West can easily be exaggerated in gaming scenarios. China and most Asian-Pacific nations have unique cultural values that differ significantly with Western cultural values. Games designed on the tenets of these varying cultural values have a propensity of being more popular domestically as opposed to internationally. This enhances our understanding as to the reasons why Korean and Chinese games have a wider-acclaim both locally and in Asia-Pacific nations. To gain market share in a specific market, the cultural values of the target demographic is a critical factor for consideration during the design process. Domestically developed games are extremely popular with local gamers, because these games are designed with cultural values that local gamers are familiar with and can relate to. A current trend in domestically developed games is to base the plot and gameplay of a game title on a popular TV drama, which is usually released simultaneously with the game.

Advances in technological infrastructure for game play and regulation: This is a composite factor, made up of broadband infrastructure, Internet cafes, mobile networks and personal computer development. Development in all these factors has stimulated growth in the online game sector as well. The development and penetration of broadband technology in China signaled the commencement of a new era. It has been an important driving force in the growth of online gaming business in China (Nystedt, 2007). With the prevalence of broadband connectivity, Internet cafés sprung up all over major cities in China. Internet café are convenient and cost-effective locations for broadband Internet connections. Due to the high stability level of Internet connection required by online games, coupled with cost issues, Internet cafés have become favorite locations for playing online games. PCs, laptops, tablet PCs and mobile phones are the most popular online game access devices. As of 2005 China's personal computer market was ranked second globally. China had an estimated 67.4 million personal computers in use at the time, however the penetration aggregate was only 5.2 per 100 users (Gartner, 2006). The size of mobile internet users in China reached 557 million by the end of 2014, which represents an annual increase of 56.72 million (CNNIC, 2014). Mobile Internet users represent a high proportion of the total netizen population, accounting for 85.8% of the entire population. This population has been on the increase with the rapid development and spread of mobile technology in China. With the popularization of 4G networks, mobile games have experienced an explosive growth, hence fostering the growth of the online gaming industry.

Government regulations and policies: The Chinese government is very protective and supportive of the online gaming industry. This fact is evident in the policies and regulations formulated and proposed to regulate the industry. Government policy developers, academicians, researchers and military leaders place great emphasis on self-reliance and domestic development of technology (Simon, 2001). ErnKvist and Ström (2008) noted that the government imposed restrictions on activities of foreign game companies. The reason for this restriction is two-fold. Firstly, the restrictions were put in place to promote a "healthy" game industry, that in turn produce games that conform to the unique cultural values of the locals (devoid of pornography, violence, etc.). Secondly, the regulations provided the government with tools suitable to combat issues inherent in gaming such as addiction and Internet gambling (Golub and Lingley, 2008). Government policies in the online game industry are fundamentally directed to enhancing the development and service capability of local online gaming enterprises. The government has also provided training programs to groom online game developers and designers (Fowler and Guth, 2004; Xinhua News Agency, 2006). Ernkvist and Ström (2014) stated, "The Chinese government has sought to create a strong domestic online game industry through the use of industry policies that are often ambiguous, (…) they have "imposed several forms of regulations regarding the design of the games themselves and their services since the inception of the industry".

Piracy: Issues of piracy were heavily entrenched in gaming prior to the advent of online games in China. Piracy was one of the factors that dissuaded foreign console gaming giants such as Sony and Microsoft from engaging in the Chinese game market. In the early 2000s there were no effective laws to curb piracy, as a consequence it became so prevalent, that it was considered a barrier to development of the local console gaming industry. Offline games and online games differ considerably, while it is easy to pirate offline and console games, it is extremely complicated to do so with online games. Online gamers gain access to online games via the game operator's servers. Most online games utilize the free-to-play revenue model, hence rendering piracy redundant. The complex nature of online games makes it rather impossible to be pirated. Online games, are not just commodities, they are services.

The service aspect of online games makes piracy much more difficult to accomplish. There have been instances of pirated servers, but their impact on the market is negligible.

Mutations of business models: Online game enterprises in China continually adapt their business models to conform to the latest trends and preferences of gamers (KPMG, 2007). Most enterprises/game operators adopt the free-to-play revenue model; this model however comes with the attachment of item-transaction. Other companies adopt revenue models best suited for their gamer demographic. By the end of 2014,paying gamers accounted for 24.9% of PC online game users, with a monthly payment ranging from 11 RMB and 300 RMB (CNNIC, 2015). Shanda Games is an example of an online game company that slightly modified its revenue model by offering free access to older game titles, while charging for items that enhanced game play.

Industry Structure: The entrance of Chinese online game companies into the gaming industry signaled a transformation. It is a transformation from just game importers, licensers and distributors to game developers, operators and service providers. As a result of this transformation, the annual reports of Tier-1 Chinese game companies reveal rapid growth in revenues. Several Chinese online game companies are listed on foreign stock exchanges. An additional consequence of they transformation is the increase in the number of exported Chinese games. Several locally developed games are currently sold in South Korea and Japan (Ewing, 2007; PR Newswire, 2007a). The first domestically developed game that was exported was the game Voyage Century. It was exported to South Korea in 2004. Exports of locally developed games have increased in the past few years. Exports of online games have been growing faster than total revenue at an annualized rate of 63.3%. Revenue from export was estimated to be $1.0 billion in 2013, which is 7.9% of the total industry revenue. The cultural aspects of Chinese games have restricted its global diffusion, however its low cost still makes it attractive to gaming agencies that are keen to introduce and localize these games in their respective nations. With the continued development of local game companies and enhancement of locally developed games, industry exports are projected to reach $2.3 billion by 2018, thereby accounting for 8.1% of total industry revenue. ACMR-IBIS World forecasts that in the years leading up to 2018, the online game industry in China will grow at an annualized rate of 17.8% to reach $28.9billion. However growth is expected to slow, this is due to decline in the industry's main market-the 15-34 ages, because of China's birth control policies. Growth in the number of online game companies is expected to slow as competition intensifies. Chinese online game companies were previously lagging behind the foreign counterparts in terms of development capabilities, however in recent years, the gap in development capabilities has increasingly narrowed, leading to joint venture partnerships and synergistic cooperation between foreign companies and Chinese enterprises (Ewing, 2007;iResearch, 2015;Pacific Epoch, 2006).

Chinese Online Gaming Companies-A Firm-level Analysis

Several online game companies operate in China. This study selects ten largest online game companies/operators based on revenue accrued as of the third quarter of 2013.

Tencent ranked first with revenue of 8.42 billion RMB, followed by Net Ease, ranked second with revenue of 2.10 billion RMB. Changyou had revenue of 980 million RMB, closely followed by Shanda Games with revenue of 960 million RMB, ranking third and fourth respectively. Perfect world came in the fifth position with revenue of 750 million RMB. Giant Interactive, Qihoo 360, Kingsoft, Huanju.cn and TaoMee ranked sixth, seventh, eighth, ninth and tenth, with revenues of 581 million RMB, 407 million RMB, 271 million RMB, 154 million RMB and 63 million RMB, respectively. Although competition amongst these enterprises is stiff, it is however evident that the Tier-1 companies like Tencent and NetEase are dominating the industry (go-globe.com;en.wikipedia.org;iresearch.cn). According to iResearch, Tencent has a commanding lead among the first-tiers companies, with balanced development of three kinds of games. In 2014, Tencent experienced a 40.2% year on year growth. NetEase had a 16.7% year on year growth. Changyou and Shanda had a -3.0% and 13.0% year on year growth respectively in 2014. In the current online gaming environment, leading game operators are expected to maintain their lead of the industry in both revenue and population of diverse innovative products. They are likely to gain more dominance as the market consolidates, and as their large user bases allow then to acquire new titles from overseas, or develop more differentiated products.

Chinese online game companies are continuously exploring new opportunities and expanding their portfolios to include new game categories, such as web games, casual games, Mobile games and SNS games, these additions have a strong appeal to younger generation of gamers. At the end of 2014, the products and services offered by Chinese online game companies had the following component categories; competitive game platforms, which had a share of 11.7%, MMOGs which had the highest user stickiness, it had of 65.7 share, Mobile online games had a share of 7.4%, social games had a share of 4.0%, web games had a share of 7.2%, other categories had a 4.0% share.

Various benchmarks are commonly employed in measuring the popularity of an online game, namely: Peak Concurrent Users (PCU), daily active player base and the net number of registered users for a specific game. According to Tech in Asia (techinasia.com), the top ten most popular games in China are :1) League of Legends ,2) DNF (also called Dungeon and Fighter, Dungeon Fighter Online ,etc.), 3) Cross Fire, 4)QQ Speed, 5) QQX5, 6)Dream of Three Kingdoms, 7)Against War, 8)NBA2KOL,

9) Fantasy Journey to the West and 10) Counter-Strike Online. Tech in Asia based its measurement parameters on which games were the most played in China's Internet cafés.

With growth in capital and human resources, online game companies are releasing an increased number of games each year. In the meantime, industry competition has intensified, especially with products becoming less dissimilar, lacking differentiating features. It has become increasingly difficult to produce hit titles that can satisfy gamer's demands.

INNOVATIONS AND PRODUCTIVITY

Ariel Pakes and Zvi Griliches measured 'inventive output', using patent data in their paper " Patent and R&D at the Firm Level: A First Look". They drew a conclusion that there is a statistically significant relationship between a firm's R&D expenditure and the number of applied and granted patents. The authors portrayed this relationship between R&D and patent as a 'knowledge production function'. However, not all innovations are patented and there is a large degree of heterogeneity among firms' propensity to patent. Ergo, the role of patenting, as a barrier to imitation is relative and the degree of importance vary between sectors and firms.

Another approach for evaluating the innovation productivity link is measuring R&D expenditure. It is of popular opinion that expenditures on R&D and investments in machinery and equipment combined with knowledge labor and ordinary labor have the most impact on a firm's performance (Griliches, 1998; Romer, 1990; Geroski, Machin and Van Reenen, 1993; Jones, 1995; Van Reeneu, 1997). Firms innovate in order to seek 'rent' (J Schumpeter,). Firms' investment in knowledge and capital is generally for the sole purpose of increasing its competitiveness and capability in order to earn 'rent'. Ericson and Pakes (1995) proposed that the random outcome of a firm's investment in R&D combined with physical and human capital as well as marketing and the competitiveness pressure from other firms within or outside the industry in which the firm is situated, determines the sales performance, profitability and growth of the firm.

Regardless of the fact that this approach is codified, it still fails to capture/measure the innovation productivity link effectively. Since R&D is an input into the innovation process, it is not a suitable tenet to base the measurement of innovation productivity measurement on.

This paper employs a different approach. This approach of estimating the innovation productivity link is built on a micro-dataset. The data is representative of the firms' product and process innovations, innovation expenditures, R&D and other knowledge investments, co-operation, obstacles to innovation and the relative importance of various knowledge flows. This approach not only measures R&D, it also measures the firms' intangible assets, combined with the appropriation of sales generated by new products and the implementation of process innovations as a measure of innovation outputs, in lieu of patents.

Griliches (1979) stated that the production function approach with a focus on total factor productivity or labor productivity as a function of prior R&D-investments, physical capital, human capital, firm size and sector specific factors, is the only method of effectively estimating the contribution of R&D to growth. The knowledge function is the most-widely accepted approach for modeling the relationship between innovation and its determinants, and the impact of innovation on productivity is generally modeled in an output production function (Griliches 1979;Griliches and Pakes, 1980). This approach is hinged on the assumption that present and previous investments in new knowledge as well as external knowledge flow influence the production of new knowledge. This approach illustrates the translation of innovation inputs into innovation outputs, and its impact on productivity. The fundamental principle of this approach is that innovation inputs determine innovation output, which in turn affects productivity. Based on the knowledge production function proposed by Griliches, Crépon, Duguet and Mairesse (1998) developed a structural model of the innovation process, delineating the relationship between innovation input, innovation output and productivity. The Crépon, Duguet and Mairesse model (henceforth CDM-model) utilized data from the French Community Innovation Survey in estimating their model.

THE MODEL

The model used in this paper is similar to the CDM-model. Just like the CDM-model, this model is also comprised of three steps, namely:

First Step: Firms' decision to engage in innovation activities and the amount of innovation expenditure (R&D decision and R&D intensity).

Second Step: The Innovation output productivity link. This step models the knowledge production function, describing the relationship between innovation input and innovation output.

Final Step: The Innovation output productivity link. The final step utilizes an improved Cobb-Douglas production function to estimate the innovation output productivity link.

Prior to implementing the structural model, this study estimated three and Ordinary Least Squares (OLS) models, with the aim of ascertaining the influence of the set of variables on the following factors:

Probability to engage in innovation/innovative activities, the degree of innovation inputs employed, labor productivity

The models are depicted in the following format:

(1) Probability to engage in innovation=β1 + β2log (employment) + β3group + β4foreign market+ β5obstacle: knowledge + β6obstacle: market+ β7obstacle: cost+ βisector + u

(2) Log (innovation input)=log (innovation input) = β1 + β2group+ β3foreign market+ β4innovation cooperation + β5public support + βisector+ u1

(3) Log (innovation output)=β1 + β2log(employment) + β3group+ β4process innovation + β5log(innovation expenditure per employee) +βisector + u

Based on the simplification of the CDM-model by Lööf and Heckman (2002), the model used in this paper can be presented in the following form:

$$y_{0i} = \begin{cases} 1 & \text{if} \quad y_{0i}^{*} = X_{0i}\beta_0 + \varepsilon_{0i} > 0 \\ 0 & \text{if} \quad y_{0i}^{*} = X_{0i}\beta_0 + \varepsilon_{0i} \le 0 \end{cases} \tag{4}$$

$$y_{1i} = y_{1i}^{*} = X_{1i}\beta_1 + \varepsilon_{1i} \quad \text{if} \quad y_{0i} = 1 \tag{5}$$

$$y_{2i} = \alpha_{21} y_{1i} + \alpha_{23} y_{3i} + X_{2i}\beta_2 + \varepsilon_{2i} \quad \text{if} \quad y_{0i} = 1 \tag{6}$$

$$y_{3i} = \alpha_{32} y_{2i} + X_{3i}\beta_3 + \varepsilon_{3i} \quad \text{if} \quad y_{0i} = 1 \tag{7}$$

Model Specifications

According to Crépon, Duguet, and Mairesse, it is innovation input that increases productivity. Based on this background it can be proposed that firms engage in R&D investments to improve process as well as to introduce new products, a spillover of this investment in innovation is the significant increase in productivity.

The first equation of the model is estimated using a generalized Tobit model, also referred to as the Heckman selection model (Heckman, 1979).(8) Probability to innovate = β1 + β2log (employment) + β3group + β4foreign market+ β5obstacle: knowledge + β6obstacle: market+ β7obstacle: cost+ βisector + u This equation explains the firms' decision to engage or not to engage in innovation activities. With reference to equation (6), the subscript i represents firms; X represents the vector of regressors and sigma represents error term, which is normally distributed. It uses the generalized Tobit model to model the probability of a firm innovating. The inverse Mills ratio is estimated in this stage as well. The ratio is used as a regressor in the second and third steps of the model to correct for selectivity. The first equation measures the probability of the firm to innovate based on the size of the firm, which is measured as the logarithm of employment. Other parameters used in the measurement include, whether or not the firm is part of a group (dummy variable), whether or not it serves a foreign market (dummy variable), whether or not it has experienced obstacles of various kinds in pursuit of innovation, and the industry sector to which it belongs.

Table 2:Independent variables used in Equation 8

Variables involved in the Equation 8
Size = Measured as the log of Employment
Group = Dummy variable indicating whether or not the firm belongs to a group
Foreign market= Measured as a dummy variable which indicates whether or not the firm has foreign market share
Obstacle in Knowledge= Measured as a dummy variable
Obstacle in Market= Measured as a dummy variable indicative of obstacles with respect to market
Obstacle in Cost + Measured as a dummy variable indicative of cost related obstacles
Industry Dummy

The second equation of the first stage is given in the form:

(9) Log (innovation input) = β1 + β2group+ β3foreign market+ β4innovation cooperation + β5public support + βisector+ u; if innovation =1

The above equation explains the innovation intensity of the firm. When innovation =1, which is indicative that the firm is engaged in innovation activities, then the second equation of the first stage which provides a framework for estimating the innovation intensity of a firm is implemented. In this equation the dependent variable is the logarithm innovation expenditure per employee.

The variables used to estimate the second equation are whether or not the firm belongs to a group, whether or not the firm is operating in a foreign market, whether or not the firm is engaged in co-operation and whether or not the firm is receiving financial public support.

Table 3:Independent variables used in Equation 9

Variables involved in the Equation 9
Group = Dummy variable indicating whether or not the firm belongs to a group
Foreign market= Measured as a dummy variable which indicates whether or not the firm has foreign market share
Co-op= A dummy variable that indicates whether a firm is engaged in cooperation or not
Industry Dummy
Financial Support = Dummy variable indicative of whether or not a firm received public financial support

The third equation is given in the form:

(10) Log (innovation output) = β1 + β2log (employment) + β3group+ β4process innovation + β5cooperation: customer+ β6 cooperation: supplier + β7 cooperation: other firm+ β8 cooperation: public organization+ β9mills ratio + β10log (innovation expenditure per employee) +βisector + u; if innovation =1

This equation models the knowledge production function. Instrumental variables estimator is utilized here to treat for potential endogeneity, due to the fact that some of the explanatory variables in the model might be simultaneously determined as the dependent variables. The dependent variable in this stage is the logarithm innovative sales per employee, which depends on the intensity of investment in innovations, firm size, whether or not the firm is part of a group, process innovation, collaboration with other firms; clients, suppliers, private and public agents and industry dummies. The Mills ratio derived from the first stage is used here to correct for selectivity

Table4: Variables in Equation 10

Variables involved in the Equation 10
Size = Measured as the log of Employment
Group = Dummy variable indicating whether or not the firm belongs to a group
Process innovation= Dummy variable indicative of whether or not a firm introduced a new or significantly improved production process
Cooperation: client
Cooperation: Supplier
Cooperation: other firms
Cooperation: public organization
Inverse Mills ratio
Innovation input =Measured as innovation expenditure per employee in log
Industry dummy

The final equation is given in the form:

(11) Log (labor productivity) = β1 + β2log (employment) + β3group+ β4process innovation+ β5mills ratio + β6log (turnover with new products per employee) + βisectori + u; if innovation =1

Instrumented log (turnover with new products per employee)

Instruments: log (innovation expenditure per employee), cooperation: customer, cooperation: supplier, cooperation: other firm, cooperation: public organization.

The regression uses innovation output (which is measured as sales income from innovation products per employee (in log)) as the dependent variable to estimate the impact of innovation output on productivity. An augmented Cobb-Douglas production function is used as the basis for this estimation. The independent variables include size (log of employment), firm group (dummy variable), process and log innovation sales per employee. The instrumental variables 2-stage least squares are utilized to correct for potential endogeneity of log innovation sales per employee. Owing to the usage of Mills ratio and predicted innovation input, bootstrapping of standard errors was implemented in both the innovation and output production function.

Data

The data employed in this paper was obtained from modified questionnaires designed in accordance with the Oslo Manual for Innovation Surveys and designed to capture the nature and dynamics of innovation-productivity link in the Chinese online gaming industry. Supplementary data was also obtained from other sources in order to ensure the accuracy, reliability and robustness of the data collected for empirical analysis.

Due to the absence of detailed and standardized innovation database similar to the Community Innovation Survey database, the author resorted to conducting a sample survey in addition to obtaining relevant data from the financial reports of the respective enterprises observed in the research. The reference period of interest was innovation activities carried out between the periods of 2010 to 2012.

The survey was designed based on the recommendations of the OECD OSLO Manual. The survey targeted innovations in the online game industry only, and it addressed innovation at the firm level. It fundamentally addressed the four types of innovation, namely: product innovation, process innovation, organizational innovation and market innovation. The survey as designed to observe and obtain detailed information on the observed firms' innovation activities, which include whether a firm's innovation activities were successful, ongoing or abandoned during the reference period. It also focused on discovering what prompts firms to engage in innovation activities and their objectives of doing so therewith. The survey explored the variety and structure of the observed firms' connection to sources of information, funding, technology transfers and knowledge resources. The survey went further to determine the degree of importance that certain factors played in hindering the observed firms' from attaining its

innovation goals. These factors include: strong price competition, strong competition on product quality, reputation/brand, lack of demand, innovations by competitors, dominant market share held by competitors, lack of qualified personnel, lack of adequate finance, high cost of access to new markets, and high cost of meeting government regulations or legal requirements. The survey went further to ascertain the percentage of the observed enterprises employees that had tertiary degrees during the reference period. The survey also determined the impact of patents, design registration, copyright, trademark, complexity of goods or services, and lead time advantages as well as secrecy on increasing the competitiveness of product and process innovations of the observed firms during the reference period.

The design and data collection phase of the sample survey were carried out online (web link will be provided on request). As a result of limitations in funding and processing burdens, the author chose to conduct a sample survey, instead of a census. However, the sample survey conducted and used in this study is representative of the fundamental qualities of the target industry. The sample enterprises involved in the survey was robust and large enough to provide reliable results for the units in the online game industry (target population). The number of responses required to obtain reliable results was derived by estimates of acceptable coefficients of variation. Finally the sample survey utilized stratification techniques. The Oslo Manual recommended that size and principal activity of the statistical units be factored into the stratification of random sample innovation surveys.

Results

The primary aim of this dissertation is to determine whether a firm's productivity performance is correlated with innovation, if so, what factors correlate with the firm's innovation practices.

The fundamental variables of concern in this empirical estimation are: productivity (defined and measured as the log of sales per employee) (ideally, productivity should be measured in terms of value added, instead of in terms of sales), innovation output (measured as the log of turnover from product innovations per employee), innovation input (measured as the log of innovation expenditure per employee), as well as the production-function variables labor force, human capital and physical capital. Human capital in this study is presented as the percentage of employees of the observed firm that had a tertiary degree during the reference period of 2010 to 2012. First, the propensity to engage in innovative activities increase with firm size, this is in confirmation with other empirical findings from current literature. The larger the firm, the larger its likelihood, to engage in innovation activities. The market orientation of firms plays an important role in the product innovation perspective. Global and local markets have varying degrees of requirements on participating firms. Firms that operate in an international market have a higher likelihood of being innovation-intensive with respect to the nature of products they produce and the cycle of producing new or significantly improved products. Such firms tend to produce new or significantly improved products in a shorter time frame/cycle with a seemingly constant regularity, as a result of the high level of competition ubiquitous in the global market place. Firms with a low degree of international market orientation, or firms that do not operate on international markets in contrast are not as product innovation-intensive.

The estimation for grouping (whether or not a firm belongs to a group) returned a positive and significant point estimate, implying that grouping is positively correlated to innovation, in other terms, firms that belong to a group have a high likelihood of engaging in innovation. The estimates derived from the selection equation of the Heckman model in this study are in conformity with results from extant literature, which implies that the probability of a firm to be engaged in innovation activities is positively correlated with firm size, foreign market operation as well as the different obstacles hampering innovation activities. The fact that the probability to innovate is also an increasing function of the different obstacles hampering innovation might seem contradictory at first, but if the issue of obstacles is perceived as being a relevant part of a firm's effort to engage in innovation, it no longer becomes contradictory. An innovative firm is defined as a firm that has innovation expenditures, turnover from innovation products and engages in a form of innovation, whether ongoing, abandoned or successful, since there is a likelihood of a abandoning an innovation process, then factors with the potential of hampering innovation need to be factored in, ergo they are relevant. This seeming contradictory result may also be interpreted to mean that the innovative firm is constantly exploring and implementing new ideas.

Estimates from the outcome equation of the Heckman model show that once a firm has decided to be engaged in innovative activities, the grouping variable (whether or not a firm belongs to a group) does not have any effect on the amount of innovation input (defined and measured as the log of innovation expenditure per employee) of the firm. It further reveals that the amount of a firm's innovation input correlates with cooperation on innovation with other firm and market orientation (foreign market).

Further analysis of the empirical results reveal that although larger firms tend to have a higher number of product innovations, however the innovation input tends to decrease with firm size. Earlier on in this section, innovation input was defined as the log of innovation per employee, it can be deduced from this definition that the larger the firm the lower the input to the innovation process per employee. It can therefore be proposed that smaller firms achieve a higher input to the innovation process per employee. This result is contradictory to most empirical research in this area. Worthy of mention is the hypothesis of a non-linear U-shaped relationship between innovation intensity and firm size put forward by Kamien and Schwartz (1975). The value of the

Chi2 statistic suggests that the error terms of the Heckman model equations, namely: selection and outcome equations are not correlated, thereby implying that the first step of the model is far from satisfactory.

Instrumental Variable Regression: Innovation Output**:** As previously delineated, innovation output (defined and measured as the log of sales income from product innovations per employee), is determined by innovation intensity. Coefficients derived from this estimation reveal that there is a positive correlation between innovation expenditure per employee and innovation output per employee, this is in conformation with results from similar empirical studies. However the value of the coefficients obtained in this study are larger than those obtained in other studies. Examples of such studies include but are not limited to Crépon, Duguet and Mairesse (1998), Lööf and Heshmati (2002), Lööf et al. (2003), Ebersberger and Lööf (2005), Janz, Lööf and Peters (2004), and Janz, Lööf and Peters (2004). All these studies have elasticity within the range of 0.01-0.40, and had a concentration of about 0.10. The elasticity value derived in this study is however more in line with recent studies that suggest that the correlation estimates between innovation output and innovation expenditure should be in the range of 0.20-0.40. It is evident from the empirical results that the point estimates for the correlation between the log of innovation sales and the log of innovation expenditures are feasible albeit not statistically significant. The predicted mills ratio was included in this estimation to correct for selection bias, however the results do not indicate a statistical significance.

The estimation results show a negative size effect on innovation input. This can be interpreted to mean that smaller firms accomplished a higher innovation output per employee. The group variable estimate is significant, indicating that firms, which belong to a group, tend to have an easier access to global knowledge, which in turn could be positively correlated, wit its performance.

The cooperation variable, which is a compound variable detailing cooperation with various partners, is not related to innovation output. In other terms the estimates derived do not show any definitive impact, so it can be postulated that cooperation partners are not in themselves pertinent to a firm's innovation performance. This is in conformance with previous empirical findings in other literature.

Finally it can be deduced from the results that changes in physical capital (defined and measured as the log of gross investments in tangible goods per employee) is positively related to innovation expenditure.

Instrumental Variable Regression-Labor Productivity: This section dwells on the productivity effects of innovation. From the empirical results of this instrumental variable regression, it is observed that the point elasticity for innovation output (which was carried forward from the previous instrumental variable regression) is statistically significant. This outcome conforms to the authors a priori expectation. The outcome also signifies that a firm's performance, measured as a function of productivity, increases both in size and value with innovation output.
The results of the estimation also reveals that productivity increases with firm size, in contrast human capital does not display any significant effect in explaining productivity. The number of employees with a tertiary degree is not correlated with firms' performance.

Further deductions from the empirical findings show that market orientation affects productivity. Firms with a global market orientation have a better firm performance. On extrapolation, it can be deduced that the export share of firms with a global market orientation is significant and positively correlated with labor productivity. The Inverse Mills ratio was included in this stage of the estimation to treat selectivity, and it is quite significant thereby emphasizing a selectivity issue.

Due to the fact that this study focused on knowledge intensive firms with a high level of propensity to innovate, it is therefore not surprising that the estimates of productivity effects of innovation output seem higher than those obtained in similar empirical studies, for instance, Griliches (1998) and Lööf and Heshmati (2003). Analyzing both quantitative and qualitative variables used in this econometric estimation, there is an evident variation in the size of the coefficients of quantitative variables, however the variations are not sizable, ergo, they are not considered statistically significant. On the other hand, the variations in the size of the coefficients of qualitative variables are quite significant, both in strategies for innovations and firm wise framework.

Sensitivity Test
In order to test the robustness and reliability of the obtained results, a sensitivity analysis was conducted. The results obtained from the structural model estimation were compared and contrasted with the output estimates of the OLS regression performed prior to the structural model estimations. The OLS regression results for the innovation output equation and the productivity equations were utilized, the estimates of emphasis are the innovation input and innovation output. Fundamentally, this sensitivity test focused on the elasticity of innovation output (log innovation sales per employee) with respect to innovation input and the elasticity of productivity (log sales per employee) with respect to innovation output. A comparison of both empirical findings (simple OLS regressions and Structural model estimations) reveals that the estimates derived for this elasticity are significant, although there are nuances in the variables of interest. Deductions from both estimations show that innovation output is an increasing function of

innovation input and that labor productivity has a significant impact on innovation output. Although the estimates in both results are significant, however the OLS estimates are more in-line with results from similar empirical studies. In view of the absence of contradictory variations, it can therefore be concluded that the results derived from the estimation are robust and reliable. The econometric model implemented in the estimation is also considered robust.

CONCLUSION

This study has explored the impact of innovation on productivity in the Chinese online game industry, by extension it has delineated and captured the dynamics of innovation in firm performance in firms in creative industries. It has empirically studied the links between innovation and productivity at the firm level using the Chinese online game industry as the focal point of it's analysis. The dissertation based its analysis on the recommendations of the OECD Oslo Manual, an approach that provided a high level of comparability as well as definitions of standards and indicators.

Online Game Evolution in Retrospect

The study presented the evolution of the online games industry China.

The growth trajectory and the extent of innovation present in the Chinese online game industry have been examined through different focal points. The role of this industry in the society at large has also been illustrated. Factors hindering the development were also discussed and relevant statistics were presented.

In the course of the discourse on the evolution of the Chinese online game industry, it was shown that the industry is one of the fastest growing industries and it is highly competitive (Landreth, 2007). Operating from a previous position of weakness, the industry has evolved into one of the most powerful, dynamic and diverse online game industries. During its nascent years, the Chinese online game industry was positioned at the lowest level of the industry value chain, chiefly playing the role of an importer and distributor of foreign games. However in the mid-2000's, the industry experienced an influx of local firms. These firms at first were incapable of game development, but eventually they became technologically equipped to develop and operate games. This influx of local enterprises triggered the commencement of the full development of the industry. There were approximately 150 local/joint-venture online game operators, and approximately 100 game development centers in 2007. During the same period, there were approximately 30 local game enterprises marketing and distributing both domestic and foreign online games (Chung, 2007;Ewing, 2007).

As a result of firm-related innovative practices, a vast majority of domestic online game enterprises have earned very high revenues. Several of these enterprises are also listed on foreign stock exchanges. The high return on investments of these companies, coupled with being listed on foreign stock exchanges is directly attributable to the increasing competitiveness of this industry.

From the innovation standpoint, it is evident from the innovation survey and analysis implemented in this study that innovation is a primary driver of growth in the online game industry. A high percentage of all observed firms were engaged in various forms of innovation and to varying degrees during the reference period.

Creative Industries and Innovation

Innovations are ubiquitous in creative industries; innovations in creative are manifested in various forms. However, not all manifestations of innovations are technologically intensive. Innovations can be radical or marginal, radical innovations involve new paradigms leading to technological revolutions as well as significant economic impact, while marginal innovations in contrast are combinations of existing innovations to create added value. The latter kind of innovation is more commonplace in creative industries.

A vast majority of innovations in the creative industries go unnoticed or under-reported. This phenomenon is due to the fact that a large proportion of small makes up the creative sector and medium enterprises, and they are under-represented in innovation and R&D surveys. Green et al, (2007:58) and Söndermann both referred to this as 'hidden innovations'. The extent of these hidden innovations make it particularly cumbersome to evaluate innovations and its attendant effects on firm performance in the creative industries. Traditional innovation metrics designed primarily for manufacturing industries can hardly capture the mechanisms and dynamics of innovation in the creative industries. Therefore this dissertation concludes that a more robust and differentiated concept of innovation should be established to take into consideration the unique features and dynamics of the creative industries and service sectors. The extant definitions of innovation has limiting effects on innovation, firstly, it fails to acknowledge the innovation potential of creative industries and service sectors, secondly, it limits incentive promotion to technological innovations, thereby ignoring to a large extent the creation potential of creative industries. Thirdly, with respect to established incentive programs. The concept of innovation is at odds with the manner in which creative industries operate. Finally, the creative sector will not experience growth in the absence of favorable innovation policies, because innovation is the driver of growth.

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APPENDIX

Table 1: Summary descriptive statistics for indicator variables

	All firms		Innovative firms	
	Mean	Std. Dev.	Min	Max
Group	0.61	0.45	0.73	0.62
Foreign Market	0.59	0.47	0.80	0.43
Knowledge obstacles	0.15	0.36	0.18	0.36
Market obstacles	0.26	0.43	0.30	0.42
Cost obstacles	0.29	0.45	0.33	0.44
Cooperation: customer	-	-	0.60	0.38
Cooperation: supplier	-	-	0.15	0.20
Cooperation: public org	-	-	0.56	0.44
Cooperation: Other Firms	-	-	0.79	0.39

Table 2: Heckman Equation

Independent Variables	Selection equation Dependent variable: Innovative Firm	Output equation Dependent variable: Innovation Input
Group	0.223	0.120
	(0.041)	(0.135)
Size	0.157***	
	(0.031)	
Foreign Market	0.613***	0.621***
	(0.045)	(0.164)
Knowledge Obstacles	0.319***	
	(0.081)	
Market Obstacles	-0.062	
	(0.048)	
Cost Obstacles	0.259	
	(0.046)	
Public Support		0.446
		(-0.173)
Cooperation		0.422***
		(0.173)
Sector	Included	Included
Prob>chi2		0.138
N	57	43

Table 3: Instrumental Variable Regression

Independent variables	Innovation Output Equation	Productivity Equation
Innovation input	0.188	
	(0.136)	
Inverse Mills ratio	-0.010	0.077
	(0.272)	(0.075)
Process Innovation	0.147**	-0.048
	(0.049)	(0.053)

Group	0.212**	0.068*
	(0.084)	(0.045)
Size	-0.107	0.091***
	(0.052)	(0.020)
Cooperation: customer	-0.153	
	(0.121)	
Cooperation: supplier	0.254*	
	(0.114)	
Cooperation: Public Org	0.036	
	(0.112)	
Cooperation: other firms	-0.103	
	(0.123)	
Sector dummy	Included	Included
N	43	43

Table 4: Ordinary Least Square

Independent variables	Innovation Output	Productivity Equation
Group	0.188**	0.118***
	(0.091)	(0.043)
Employment	0.008	0.082***
	(0.033)	(0.014)
Foreign Market	0.0270	
	(-0.021)	
Process Innovation	0.096	-0.024
	(0.078)	(0.035)
Public Support	0.479	
	(-0.476)	
Cooperation: customer	-0.107	
	(0.117)	
Cooperation: supplier		
	0.255**	
Cooperation: Public org	(0.106)	
	0.0422	
Cooperation: other firms	(0.107)	
Sector	-0.140	
Constant	(0.032)	
N	Included	Included
	Included	Included
	43	43

Table 5: Scoring Index

Enterprise	Tencent	NetEase	Shanda Games	Changyou	Perfect World	Giant	Kingsoft	Taomee	YY Inc
Diversity in Business	★★★★	★★★		★			★★		★
Online game Innovation Intensity	★★★	★★★	★	★★	★★	★★	★★	★★	★★
Operatin	★★	★★	★★	★★	★	★★		★★	★★

Enterprise	Tencent	NetEase	Shanda Games	Changyou	Perfect World	Giant	Kingsoft	Taomee	YY Inc
g capability									
Popularity	★★★	★★★	★★★	★★	★	★★		★★	★★
Game Diversity	★★★★	★★★	★★	★★	★★	★★		★★★	★★
Development pipeline	★★★	★★	★★	★	★	★			
Local Market orientation	★★★	★★★	★★	★★★	★★★	★★	★	★★★	★★
Global market orientation	★		★★		★★★				
New to firm product innovation	★★★	★★	★★	★★	★★	★	★	★	★
New to market product innovation	★★								
Process innovation	★★★	★★	★★	★★	★★	★★	★★	★★	★
In-house R&D	★★★	★★	★★	★★	★★★	★★	★★	★★	★★
External R&D	★★	★	★	★	★	★	★	★	★
In-houseTraining	★★	★★	★★	★★	★★★	★★	★★	★★	★★
Organizational Innovation	★★★	★★	★★	★	★	★	★	★	
Market innovation	★★	★	★	★	★	★	★	★	★★