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벡터자기회귀(VAR) 모형을 활용한 온라인 게임 규제 영향에 대한 실증적 연구: 웹보드 게임을 중심으로

An Empirical Study on the Effects of Regulation in Online Gaming Industry via Vector Autoregression Model

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요 약

한국의 게임시장은 전 세계 시장의 약 29%의 시장점유율을 차지할 정도로 급성장하였다. 특히, 온라인게임의 수출 규모는 24억 USD를 달성할 정도로 국가경제에서 큰 비중을 차지하고 있다. 이렇게 게임 산업이 급성장하면서 게임 산업에 대한 국가적 차원의 정책과 규제에 대해 여러 논의가 이루어지고 있다. 특히, 웹보드 게임에 대해 정부는 여러 주무 부처를 통한 셧다운제, 행정처분, 게임산업진흥법 시행령 등 다양한 규제정책을 시행하고 있는 실정이다. 이러한 배경에서 본 연구는 2012년 11월에 이루어진 웹보드 규제정책의 영향을 분석하기 위해 2010년 12월부터 2014년 11월까지 약 4년여 간의 게임 트릭스 시계열 자료를 단위근 검정, 벡터자기회귀(VAR, Vector Auto-Regression) 분석, 그랜저 인과관계 검정을 수행하였다. 이를 통해 웹보드 규제 정책 시행 전후의 웹보드 게임서비스 간의 충격 파급효과와 예측 이용시간 변화를 알아보았다. 분석 결과를 바탕으로 웹보드 규제 정책이 실질적으로 정부가 의도한 결과대로 나타냈는지 알아보고, 나아가 웹보드 게임 산업을 보다 건강하게 발전시키기 위한 전략을 제시하고자 한다.

키워드 : 온라인게임, 웹보드게임, 규제 효과, 시계열 분석, 벡터자기회귀모형, VAR

Ⅰ. Introduction

Gaming is a fast-growing market that contains many categories such as arcade games, role-playing games and real-time strategy games. Among these, one of the fastest growing categories is online gambling games. According to a report issued by the American Gaming Association (AGA), there are about 3,000 online gambling sites that offer various gambling games and these sites generate almost USD 30 billion in annual revenue (Stewart and Gray, 2011). Although the online gambling industry has a huge economic volume, it is often

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considered a controversial one because some people think online game is a main cause in creating pathological gamblers, due to more easy access than traditional casino gambling (Cotte and Latour, 2009). Therefore, many governments have enacted regulation to effectively control online gambling (Eadington, 2004; Ma *et al*., 2014). However, the enactment of regulation is frequently a challenging task to policy makers because it is sometimes contradictory to public protection and personal freedom (Siemens and Kopp, 2011). In this vein, numerous studies have been published to help make effective regulation in online gambling (Auer and Griffiths, 2013; Gainsbury *et al*., 2012; Gainsbury *et al*., 2013; Gainsbury *et al*., 2014; Ma *et al*., 2014; Monaghan, 2009; Siemens and Kopp, 2011). However, most previous studies in this area have been focused on online gamblers' behavior, while few attempts have been made to investigate the effects of regulation on online gambling. Moreover, those attempts are generally made through case study research and quantitative evidence is limited. In response to this limitation, this paper empirically examines the effect of regulation on the dynamic changes of online gambling. In addition, it analyzes whether such regulation efforts effectively prevent addiction as is the legislative purpose of the government. It also checks for any side effects of the regulation. Therefore, the research questions are as follows:

- How does the regulation affect user behavior in online gambling games?
- Does the impact of regulation vary depending on the skill level of the individual users in online gambling?
- Does the regulation have the same influence on user behavior on each online gambling platform?

In order to empirically investigate our research questions, we narrow our focus to software-generated gambling between software-generated gambling and online betting on sports and other games (Griffiths, 2003). We expect to find the hidden impacts of the regulation using three theoretical perspectives－the role of prior experience, switching costs, and network externalities. The first perspective is related to the impact of regulation on the different levels of online gambling. The second perspective is about the impact of regulation on each online gambling platform. The last perspective is about the impact of regulation on a dominant platform in the online gambling industry.

To search for explanations to these research questions, this paper employs Vector Auto-Regression (VAR) model. Many studies have utilized VAR to investigate policy effects in various areas such as monetary policy, freeway traffic policy and national employment (Awokuse and Bessler, 2003; Bagliano and Favero, 1998; Bernanke *et al*., 2005; Chandra and Al-Deek, 2009; Heckman, 2000; Kim and Lee, 2014; Sims, 1986). In the context of online gambling, this paper compares correlations and a ripple effect on each playtime trend of the top five online gambling games by using VAR at time points both before and after the policy regulation announcement.

The rest of this research article is organized as follows. Section 2 provides related literature to build the theoretical hypotheses. Section 3 presents a brief overview of the research context, the empirical data and the methodology that is adopted to validate the hypotheses. Section 4 shows the VAR test results and analysis. Finally, section 5 discusses the theoretical and practical implications of the results and conclusions.

Ⅱ. Literature Review and Research Hypotheses

This section discusses several factors from relevant

literature such as social influence, the role of prior experience, network externalities. Based on this discussion, it develops the study hypotheses of the regulation effects on online gaming.

2.1 Social Influence

There are mixed views of acceptance and refusal of gambling. Most people perceive gambling as a relatively harmless entertainment within time and money limits, and play gambling sometimes with friends and families as an occasional leisure activity. On the other hand, other people think that social responsibility and public health are important issues in gambling so the government should control gambling activities to prevent increasing the number of addictive gamblers (Grohman, 2006; Watson *et al*., 2004). In this context, there is a rising interest in studying the effects of regulation. The important points are the regulation not only adjusts gambling activities but also changes public attitudes toward gambling. This is because the authority of the government has a huge power in public opinion and its rules enactment expresses a negative opinion of the government toward online gambling. Therefore, the regulation discourages people from gambling by reinforcing the negative perspective on gambling. This social influence has a big impact on actual gambling behavior and became social pressure to quit even though gambling is just one of many pastimes. For example, after Korean government announced gambling is one of the major addictive elements including drugs, alcohol and gambling, online gambling is considered as one of the important social problems (Business Korea, 2013).

This view of social pressure is consistent with results in the unified theory of acceptance and use of technology (UTAUT) literature indicating that social influence is a significant factor that affects the behavioral intention to use information technology (Venkatesh *et al*., 2003). Hsu and Lu (2004) find that social influence is essential to users' online game usage behavior by explaining two factors of social influence, informational and normative influences. Informational influence happens when a user accepts information gained from other users. Normative influence happens when a user conforms to the expectations of others to acquire an incentive or avoid a penalty. One expects that online gambling can be explained by this view because online gambling is one with information technology and regulation is highly related to social influence. In addition, the total playing time of online gambling can be a proxy of actual online gambling behavior. Therefore, this leads to the first hypothesis:

H1: Regulation on online gambling is negatively associated with the total playing time of users.

2.2 Prior Experience

The technology acceptance model (TAM) is one of the most significant research models on information system (IS) acceptance and continuance (Davis, 1989). It suggests two main variables－perceived usefulness and perceived ease of use－that either directly or indirectly affect the intention to use. Many researchers have extended the TAM by adding various constructs, and the majority of the refined TAM literature has studied acceptance behavior of utilitarian technology from a productivity perspective. To understanding IS acceptance behavior in non-work environments, Van der Heijden (2004) expended the TAM model by adding a new construct: perceived enjoyment. This construct measures the user's experience of enjoyment irrespective of any performance improvements that the information system may provide (Han and Kim, 2005). This paper finds that the impact of perceived

enjoyment is greater than that of perceived usefulness in hedonic systems that are primarily used for users' pleasure. Therefore, the extended TAM model can be applied to this context since online gambling games are mainly played for hedonistic or entertainment purposes in an online platform.

The moderating effect of prior experience on IS acceptance or continuance has also been studied (Karahanna *et al*., 1999; Yoon *et al*., 2013; Yu *et al*., 2005). According to Taylor and Todd (1995), behavioral intention and actual behavior have a strong relationship, and the degree of relationship is changed depending on users' experience. The relationship between behavioral intention and actual behavior is stronger for experienced users than for inexperienced users. Additionally, inexperienced users easily lose behavioral control in the development of perceived intention. In addition, Castañeda *et al*. (2007) find that users' prior experience moderates their intention to use a website by analyzing levels of website and Internet experience. They discover that experienced users think that perceived usefulness is more important but that inexperienced users think perceived ease of use is more important. Kim *et al*. (2009) also find that perceived enjoyment has a great impact on the use intention of experienced users than on that of inexperienced users. In the case of online gambling, software-generated gambling requires much time for players to develop gambling skills, and people normally play high-level games after playing skillfully on low-level games. Thus, we assume that users of high-level games have more online gambling experience than do users of low-level games.

In addition, the regulation may affect users' attitude toward online gambling, because it directly decreases website accessibility and the perceived enjoyment of users. Since the goal of the regulation is to avoid increasing the incidence of gambling addiction, it typically forces the online gambling platforms to set constraints on the access frequency and playtime. To achieve its goal, governments compel online gambling platforms to set an additional process to check users' identity whenever they access those platforms, and this additional process may negatively affects website accessibility. Furthermore, the regulation normally makes the budget restriction stricter to decrease the inclination toward gambling. Users of online gambling are likely to feel that this stricter restriction makes online gambling boring and complicated. We therefore hypothesize:

H2: Regulation on online gambling is more related to the total playing time of experienced users than of inexperienced users.

2.3 Network Externalities

An online gambling system basically provides a network that connects users to play against other users (Sieroty, 2011). The value of the online gambling system increases for users as the number of other users in the same network increase. This can be explained by the concept of network externalities, which indicates the value of a certain technology increases with the number of other users who are connected to the same system (Katz and Shapiro, 1985). Many IS researchers have considered network externalities to be among the important constructs in the TAM (Gupta and Mela, 2008; Kim and Lee, 2007; Lin and Bhattacherjee, 2008; Sledgianowski and Kulviwat, 2009; Yang and Mai, 2010) and to have a significant relationship with other constructs in the TAM such as perceived usefulness and perceived ease of use. As the online gambling system is a kind of hedonic information system, it is possible to consider network externalities to have a significant influ-

ence on acceptance and continuous usage of online gambling. Therefore, we assume that network externalities would have a positive impact on the intention to join or to continuously use a certain online gambling platform.

However, the regulation seems not to consider the characteristic of network externalities in online gambling. The government typically creates legislating to control online gambling platforms without considering the number of users in each system. The regulation is a single rule to be applied to all online gambling platforms at once. It sets a certain amount of game money as a strict criterion to control users' behavior in every online platform, rather than differentiating the criteria according to the user network size of each platform individually. However, the impact of the regulation can be different depending on the network size of users regarding network externalities. In other words, the impact of the regulation can be smaller in a bigger network. This is because the size of network externalities is greater in a larger user network, and a larger amount of network externalities has a more positive relationship with intention to use (Lin and Lu, 2011). Thus, we suppose that legislators overlook network externalities as an essential factor to determine the impact of the regulation. We therefore hypothesize:

H3-1: The impact size of the regulation on online gambling is different depending on the number of users in online gambling system.

Furthermore, users of online gambling normally tend to play on only one platform, because their in-game money or level cannot be transferred to other platforms. This kind of user behavior can be explained by the concept of switching cost, which indicates the form of transaction costs including learning costs, switching brands, or contractual costs (Klemperer, 1987). In the IS discipline, perceived switching cost is used to explain the lock-in effect or customer loyalty associated with an online service (Chen and Hitt, 2002; Deng *et al*., 2010; Kim and Son, 2009). When users perceive switching cost to be relatively trivial, they can easily change service platforms. In the context of online gambling, game money or game level can be one such perceived switching cost. In other words, users with plenty of game money and a high game level are more likely to stay in their current online gambling platform.

The regulation may decrease users' perceived switching cost because it encourages users to change platforms by setting game money restrictions on only one platform. The game money restrictions can be to restrict the total amount of money that can be wagered or the total amount of money that can be lost by a user. Theoretically, to control potential gambling addicts, the government should set integrated game money restrictions on the total game money of one user across all online gambling platforms. However, in reality, it is very hard to do this due to technical limitations since every service platform has a different technical background (infrastructure, program language, etc.). Consequently, it is difficult to control the gambling behavior of a user all across service platforms. Therefore, the second-best solution is for the government to set game money restrictions on each service platform individually. However, in this situation, users are able to take an advantage of loopholes in the regulation. They can simply avoid the game money restriction by changing their service platform when they reach the restriction. For example, when a user loses game money greater than the game money restriction on a service platform 1 and still wants to continue gambling, he or she can move on to a service platform 2, and so on. Thus, the regulation can reduce the perceived switching cost of

users while at the same time encouraging changes online gambling platforms to avoid the restriction. Based on this, we hypothesize:

H3-2: The regulation on online gambling will be negatively related to perceived switching cost of users.

Ⅲ. Data and Method

This section introduces the research context and presents a brief overview of the empirical data and VAR methodology that is applied to verify our hypotheses.

3.1 Research Context

Korea has become a big player in the gaming industry based on a high ratio of broadband Internet penetration, many Internet cafes and political factors to encourage game development (Huhh, 2008; Yi *et al*., 2008). According to a report of the Korea Creative Content Agency (KOCCA), the domestic online game market had a 28.6% market share of the world market, and experts are forecasting that it will keep its second place for the time being. Thus, the volume of online game exports is USD 2.4 billion, which is over 90% of the total game exports in 2012. Despite its industrial importance, Korean government declares that online game is the fourth major addictive element adding to drugs, alcohol and gambling (Business Korea, 2013). In addition, the government has highly regulated online gambling after announcing detailed regulation criteria on November 29, 2012, since the government considers online gambling as a main cause of generating gambling addicts. The details of the regulation include that online gambling games should permit users:

- to authenticate their IDs whenever they access the game;
- not to buy game money more than KRW 300,000 (about USD 275) in a month;
- not to wager game money more than KRW 100,000 (about USD 92) in a game;
- not to access the game for 48 hours if they lose more than KRW 100,000 game money within a day;
- not to choose their opponents by themselves;
- not to run the game automatically.

3.2 Data

The data set used for this paper is obtained from Gametrics (http://www.gametrics.com), one of the major research data providers especially about the online game industry in Korea. The main object of this company is to provide various analyses based on users' behavior data related to many computer games for game business participants such as game company owners, game developers, marketers, etc. As shown in <Table 1>, this paper focuses on the data from the top five poker games in terms of the hours of game usage to find out the effect of regulation. The merit of using the game level data set is that it is not necessary to conduct an extra survey or experiment for this paper only and this game level data set is obtained with comparative ease. Given the significant difference between each game in terms of its structure (speed of play, reward structure, role of skill, importance of strategy), the analysis based on each playing time can be insightful and warranted. The five poker games have almost a 75% share of the Korean poker game industry in November 2014. The remaining 25% is shared with seven companies and each company has less than a 5% share. Therefore, we decide to use the top five poker games data since the influence of

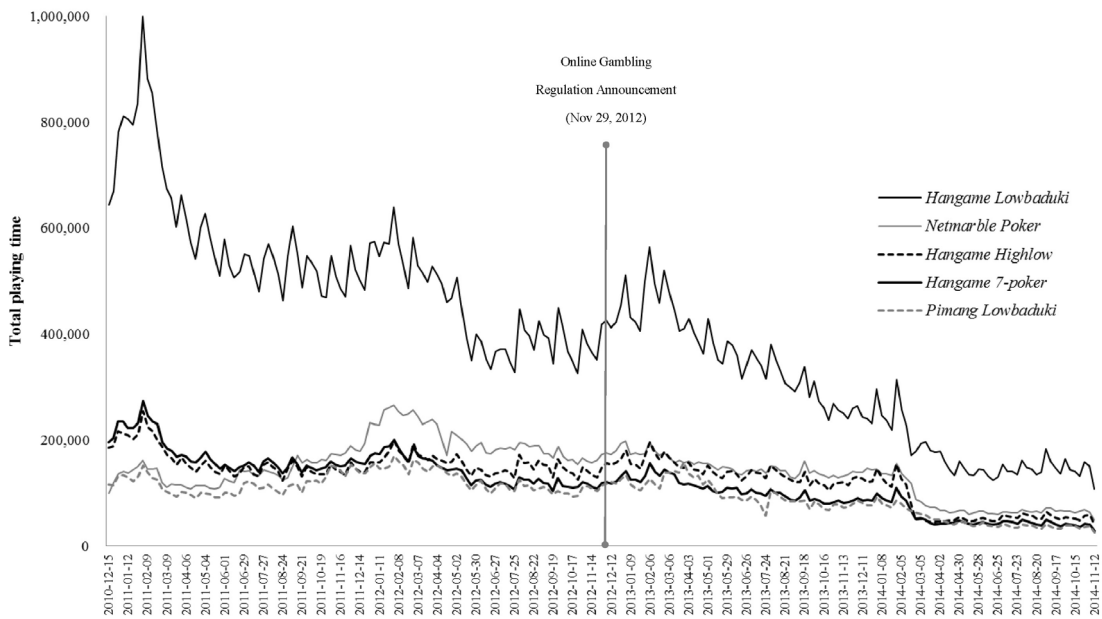
〈Table 1〉 Top-five Poker Games

Name	Company	Release date	Market share
Hangame lowbaduki	NHN Entertainment	2003-01-21	31.91%
Netmarble poker	CJ E&M	2010-12-15	14.14%
Hangame highlow	NHN Entertainment	2002-10-18	11.45%
Hangame seven-poker	NHN Entertainment	2002-10-18	8.78%
Pimang lowbaduki	Neowizgames	2003-08-13	7.78%

the other seven companies on the Korean online gambling industry is too small to investigate. There are many similarities among the poker games in terms of rules, so the share of game users participating in each poker game can be changeable depending on the attractive features. Therefore, the online gambling game providers compete with each other to acquire more of the total online gambling players.

In addition, the original data set is daily playing time per each poker game, and we aggregate into weekly data. The reason why a week is chosen as the time unit of data analysis is because people tend to perform online poker games on a weekly basis. People often play online poker games after office hours or on weekends when they have extra time to rest. These behavior patterns are similar to other types of entertainment such as participating in hobbies such as hiking or watching movies. If the data set is analyzed on a daily basis, it is possible to miss meaningful results (Ma *et al.*, 2014).

As illustrated in <Figure 1>, the trends of playing time move together in a similar pattern from December



〈Figure 1〉 Weekly Game Playing Time of Each Poker Game

19, 2010 to November 15, 2014. It seems that the five poker games have high correlations. Especially, four games (except *Hangame lowbaduki*) show high similarity of playing time trends.

3.3 Model Specification

To develop the model for the hypotheses, VAR is applied, which is a rigorous empirical research method for analyzing the dynamic relationships among variables without strict economic theory restrictions, such as the assumption of exogenous variables (Cooley and Dwyer, 1998). VAR represents a relationship among variables such as correlation and a ripple effect that can be inspected by evaluating impact volume when one variable affects the other valuables in the model. It is also good to show the relationship that can change over time and is relatively easy to interpret (Enders, 2008). In the case of the online gambling industry, many game providers are trying to have a greater proportion of total game players with a similar online gambling game style. Therefore, this paper expects that VAR can successfully show the dynamic changes among the online gambling service providers.

Even though VAR does not have many strict theoretical restrictions, one needs to check the general property of the least squares estimator in a regression for time-series data. It is the assumption of a stationary stochastic process (Hamilton, 1994). Therefore, the study conducts a unit root test to measure the stationarity of the five poker games' playing time by using the augmented Dickey-Fuller (ADF) test in E-views software. The test results shows that every level data set of each game is not stationary, while the first difference data set is stationary as illustrated in <Table 2>. The analysis using non-stationary data set may be spurious because non-stationary data set has unstable means, variances and co-variances. Thus, we choose the first difference data set of each game for this paper.

For the specification of the lag term, diagnostic checking is performed, selecting lag three (i.e. three weeks) among the several candidates based on the lowest Final Prediction Error (FPE) and Akaike Information Criterion (AIC) as shown in <Table 3>. Additionally, to check whether the data set needs a more sophisticated multiple time series analysis such as a vector error correlation model (VECM), a Johansen cointegration test is also conducted and the data set presents no significant cointegration. This result suggests that the VAR analysis is appropriate for this case.

〈Table 3〉 Lag Selection

Lag	FPE	AIC	SC	HQ
0	1.38E+39	104.3115	104.3954*	104.3455
1	1.09E+39	104.0761	104.5796	104.2800*
2	1.03E+39	104.0167	104.9399	104.3905
3	8.13E+39*	103.7818*	105.1245	104.3254
4	9.11E+39	103.8925	105.6549	104.6062

〈Table 2〉 ADF Test Results

	Hangame lowbaduki	*Netmarble poker*	*Hangame highlow*	*Hangame seven-poker*	*Pimang lowbaduki*
Level	Non-stationary	Non-stationary	Non-stationary	Non-stationary	Non-stationary
1st difference	Stationary	Stationary	Stationary	Stationary	Stationary

Ⅳ. Empirical Analysis and Results

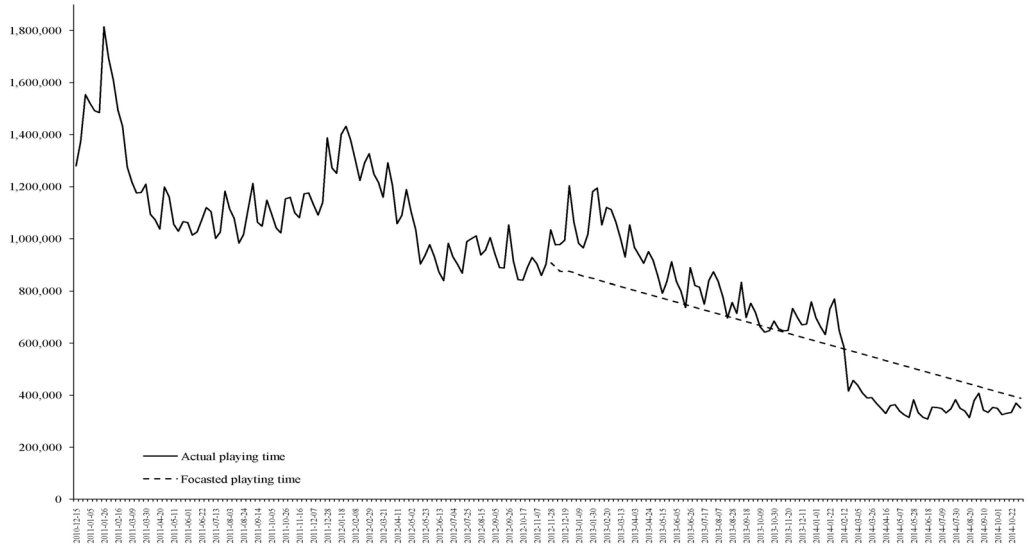
This section investigates the impact of the regulation with various perspectives. The study conducts dynamic forecasting and demonstrates interrelationship change by using VAR analysis. In detail, Granger causality analysis and Impulse Response Function (IRF) analysis are reported as standard practices for VAR analysis (Stock and Watson, 2001).

4.1 Social Influence Perspective

This paper performs dynamic forecasting for the data after regulation announcements based on the data before regulation announcements. As shown in <Figure 2>, the model's predicted value is lower than the observed one until the second week of February 2014, while the predicted value is higher than the observed one around that point. The decreasing trends of predicted and observed values are similar, and particularly, the actual playing time drops sharply around the second week of February 2014. Around that time, the regulation is systemically applied to the *NHN* games that have the largest market share, so the total playing time drops sharply.

In addition, this paper expects that the regulation will affect not only the total playing time by decreasing, but dynamics changes among online gambling games. Therefore, this paper uses VAR analysis, specifically Granger causality analysis and IRF analysis, to investigate the interrelationship changes among five games.

Granger causality test statistics indicates that the lagged variables of one variable affect the values of other variables in the VAR model (Granger, 1969). The empirical data set is divided based on the day of the regulation announcement, and a Granger causality test is conducted for each data set to compare relationship changes among five games. <Table 4> shows *p*-values of Granger causality tests, and each column of the table reveals that the effects of a particular game on all games. Before the announcement of regulation, it is evident that *Hangame highlow* and *Hangame*



〈Figure 2〉 Forecast of Total Playing Time

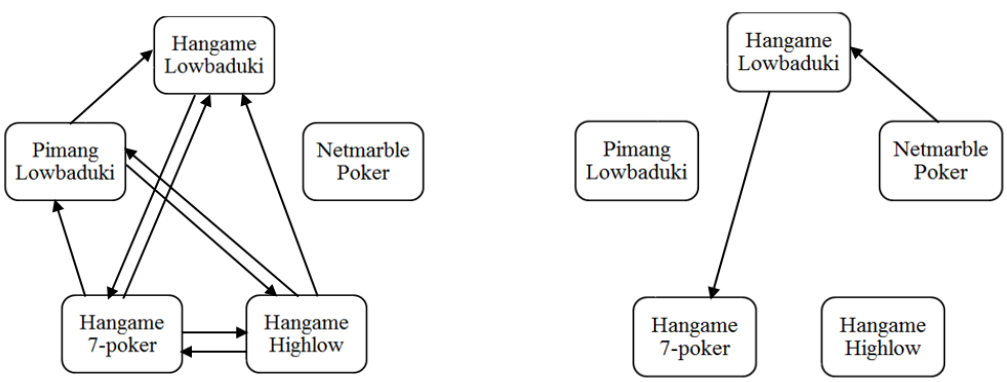
〈Table 4〉 Granger Causality Test for Five Games

	Affected Games	Affecting Games				
		Δ Hangame lowbaduki	*Δ Netmarble poker*	*ΔHangame highlow*	*Δ Hangame seven-poker*	*Δ Pimang lowbaduki*
Before	*Δ Hangame lowbaduki*		0.1566	0.0003*	0.0042*	0.0361*
	Δ Netmarble poker	0.5659		0.275	0.1965	0.7462
	Δ Hangame highlow	0.2313	0.0949		0.0164*	0.0296*
	Δ Hangame seven-poker	0.0484*	0.0514	0.0014*		0.5498
	Δ Pimang lowbaduki	0.2008	0.0865	0.0033*	0.0058*	
After	*Δ Hangame lowbaduki*		0.0295*	0.2717	0.9025	0.0684
	Δ Netmarble poker	0.2496		0.2839	0.4398	0.6215
	Δ Hangame highlow	0.2522	0.0632		0.9497	0.2622
	Δ Hangame seven-poker	0.5176	0.5081	0.797		0.1888
	Δ Pimang lowbaduki	0.0177*	0.3973	0.5619	0.4942	

Notes) H0: Column variables do not Granger-cause row variables (or sets). * indicates $p < 0.05$.

seven-poker are influential games in the online gambling industry. After the announcement of regulation, *Hangame lowbaduki* and *Netmarble poker* had slightly lower impact on other games. Furthermore, based on *p*-values of Granger causality tests, we draw a reduced form model of interactions among five poker games as shown in <Figure 3>. It shows that the interrelationship became much simpler after the announcement of the regulation. For example, before the announcement, *Hangame lowbaduki*, *Hangame seven-poker* and *Hangame highlow* have Granger causality to each other. However, after the announcement, only *Hangame lowbaduki*, *Hangame seven-poker* and *Netmarble poker* are related.

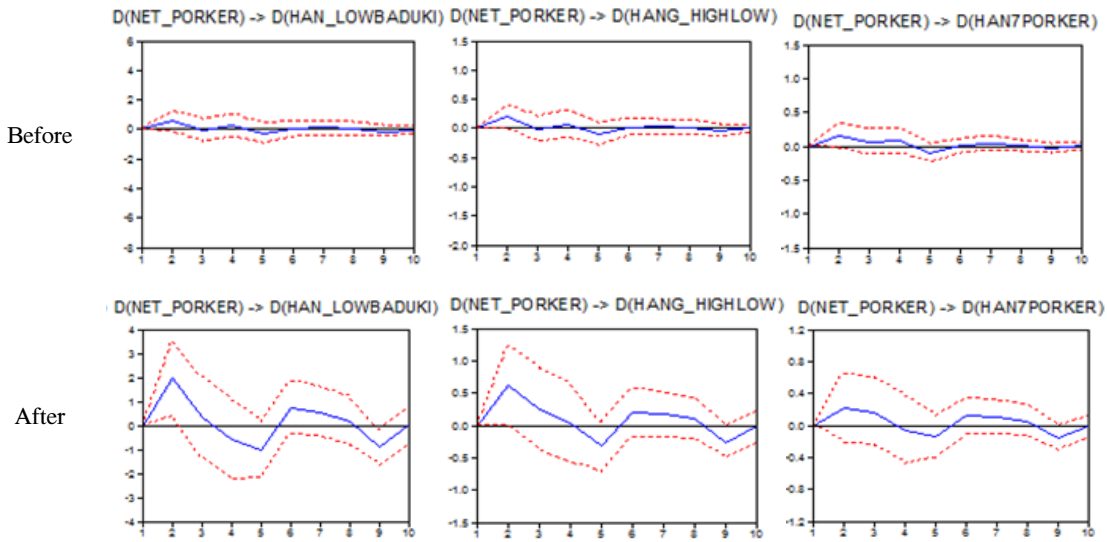
Additionally, this paper conducts IRF analysis that illustrates the response of current and future values of variables to one unit increase in the current value of one of the error terms in the VAR model, assuming that the error term returns to zero in following periods and all other errors are zero (Stock and Watson, 2001).



〈Figure 3〉 Reduced Form Model of Interactions for Five Games

This analysis is an alternative way to measure the influence of one variable on another variable in the VAR model. Each IRF plot can be interpreted as showing the corresponding response of a variable over time, given one unit increase of a responded variable at time zero. Overall, the effects magnitude of one game to another tended to increase after the regulation announcement. All possible IRFs are provided in Appendix. For example, as shown in <Figure 4>, before the announcement, the impact of *Netmarble poker* on *Hangame poker-games* is about 0.3 at the two week horizon. This implied one unit increase in the first difference of *Netmarble poker* at time zero results on average and about 0.3 unit increase in that of *Hangame poker games* two weeks later. On the other hand, after the announcement, the impact of *Netmarble poker* on *Hangame poker-games* is a value of more than 0.5. One unit increase in the first difference of *Netmarble poker* at time zero results on average and about two units increase in that of *Hangame lowbaduki* two weeks later.

Based on the comparison between the data of before and after the regulation announcement using VAR analysis, this paper discovers that the total time of online gambling decreases gradually and the interaction among the top five poker games is going to be small and simple. However, it is hard to simply say that these results show the regulation is successfully controlling and preventing an increase in the number of addictive gamblers. It can arouse a balloon effect (Friesendorf, 2005; Mora, 1996). For instance, the repression of legal online gambling can increase the number of illegal online gambling sites. People who are influenced by negative perspectives on online gambling can more easily tend to use illegal online gambling sites secretly because they are conscious of the way other people are looking at them. Indeed, Korea Communications Standards Commission (KCSC) reports that the number of deliberately illegal online gambling sites increase from 36,282 to 46,321 during



Notes) *X-axis it the forecast horizon (in weeks), and y-axis is the forecasted response of the dependent variable to a unit shock in the corresponding error term. Plots include bootstrapped 95% confidence intervals.*

〈Figure 4〉 Forecast Error Impulse Responses of Netmarble Poker (Impulse → Response)

last year (Etnews, 2015).

4.2 Prior Experience Perspective

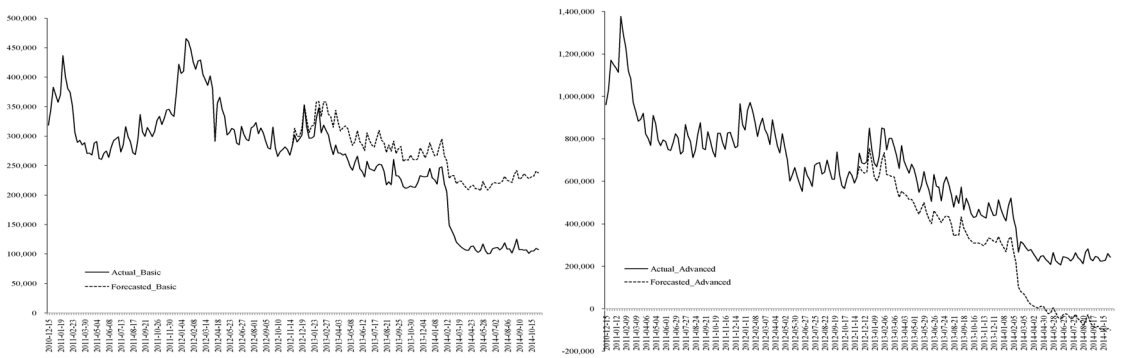
The regulators have frequently considered online gamblers as a homogeneous group. However, many researchers in IS have revealed different demographics, personality traits and psychological dimensions of online gamblers based on their online gambling activities (Ma *et al*., 2014). Therefore, this paper investigates the differences of the regulation effects by users' prior experience as described in hypothesis 2.

First, the data set is divided into two groups based on game level to investigate the effect of user experience on regulation. It is assumed that more experienced users tend to participate in the higher level of poker games. The five poker games are categorized into two groups: basic and advanced games. The basic poker games are *Seven-poker*, so-called *Seven-card stud*, while the advanced games are *Lowbaduki* and *Highlow*, which require very high level of skills. Many online poker instructions usually recommend to play *Lowbaduki* or *Highlow* poker after playing proficiently on basic poker games such as *Seven-poker* (Online Poker, 2011; Teaching poker, 2002). Thus, this paper categorizes *Netmarble poker* and *Hangame seven-poker* as basic games and *Hangame lowbaduki, Hangame highlow* and *Pimang lowbaduki* as advanced games.

Then, dynamic forecasting is performed for the playing time after regulation announcement based on the data before regulation announcement. <Figure 5> shows the model for the basic games forecasted higher than observed value. The model for the advanced games predicts lower than observed value, and interestingly it shows a negative predicted value after April 2014.

Furthermore, dynamics changes are examined between these two categories after the announcement of regulation using Granger causality analysis and IRF analysis. The first difference data set of two groups is stationary and the proper lag of VAR model is three according to the lag selection criteria. Based on *p*-values of Granger causality tests, this paper draws a reduced form model of interactions between two groups as in <Figure 6>. It presents the relationship change after the announcement of the regulation. Before the announcement, the playing time of the basic game is Granger cause of the advanced game one, whereas two becomes Granger causes each other after the announcement.

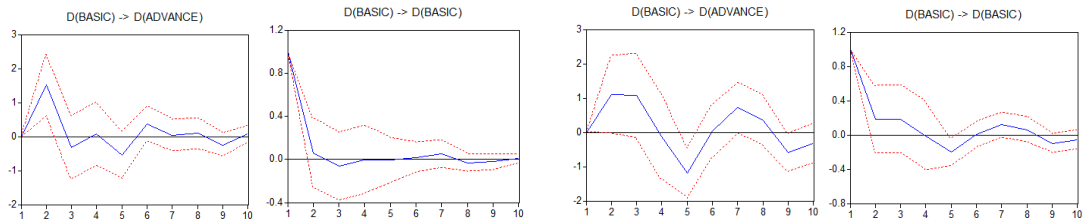
This paper conducts IRF analysis as another way to check the influence of one variable on another



〈Figure 5〉 Forecast of Total Playing Time for Basic and Advanced Games

<Before> <After>

〈Figure 6〉 Reduced Form Model of Interactions between Groups



<Before> <After>

〈Figure 7〉 Forecast Error Impulse Responses for Basic and Advanced Games

variable. The impact of the basic game is maintained longer after the regulation as shown in <Figure 7>. For example, before the announcement, the impact of the basic game on itself is 0.9 unit at the one week horizon, which indicates one unit increase in the first difference of the basic game at time zero results on average in approximately 0.9 unit increase in that of the basic game one week later. All responses before the policy converge to zero over time within approximately two weeks, whereas all responses after the policy meet to zero over time in around four weeks.

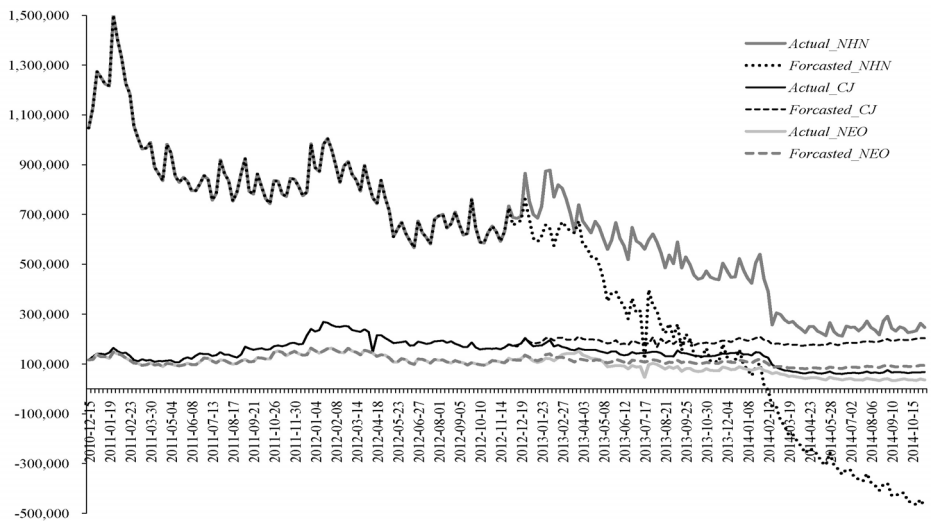
4.3 Perspective of Network Externalities

For hypothesis 3, to analyze the regulation effect on users' behavior of changing gambling websites, this paper categorizes five poker games into three groups according to online gambling service providers. Then dynamic forecasting is performed for the playing time as illustrated in <Figure 8>. The forecasted value of *NHN* is much lower than actual value, whereas the forecasted value of other companies is higher than actual value. It seems that the regulation had relatively low impact on games of the company with the largest market share. The forecasting value of *NHN* drops sharply while the actual value falls relatively gradually and this result can be a consequence of greater perceived switching cost of *NHN* game players than that of other games. The players who have greater perceived switching cost are comparatively hard to change game websites.

Therefore, this paper tries to check dynamics changes among three service providers after the announcement of regulation using Granger causality analysis and IRF analysis. As illustrated in <Figure 9>, a reduced form model is drawn of interactions between three companies based on *p*-values of Granger causality tests. It presents the dynamic changes after the announcement of the regulation. Before the announcement, the playing time of *Neowizgames* is Granger cause of *NHN* games, whereas the playing time of *NHN* is Granger cause of *Neowizgames* and that of *CJ* is Granger cause of *NHN* and *Neowizgames* after the announcement.

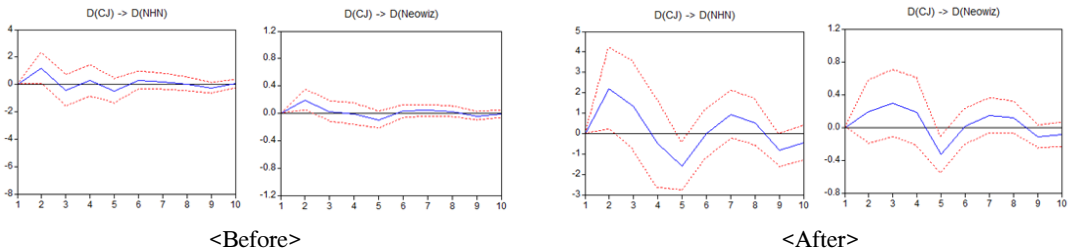
Furthermore, IRF analysis is conducted to check the influence of one company on another company.

Overall, the effects magnitude of one game to another tends to increase after the regulation announcement. For example as shown in <Figure 10>, before the announcement, the impact of *CJ* on *NHN* is about one at the two week horizon, which implies one unit increase in the first difference of *CJ* at time zero results on average of about one unit increase in that of *Neowizgames* two weeks later. On the other hand, after the announcement, the impact of *CJ* on *NHN* is a value of about two. One unit increase in the first



〈Figure 8〉 Forecast of Total Playing Time for Five Games

〈Figure 9〉 Reduced Form Model of Interactions among Service Providers



〈Figure 10〉 Forecast Error Impulse Responses for Service Providers

difference of *CJ* at time zero results on average in about two units increase in that of *NHN* two weeks later. In addition, all responses before the policy converge to zero over time within approximately two weeks, whereas all responses after the policy meet to zero over time in around four weeks.

Ⅴ. Conclusions

This paper suggests three theoretical perspectives: social influence to investigate the overall regulation impact; prior experience to find the difference of the regulation effect by individual users; and perceived switching cost to consider the regulation effect on users' behavior of changing gambling website. To the best of my knowledge, this paper provides one of the first empirical evidences that examine the effects of regulation on online game. Furthermore, in research methodology aspect, this paper also introduce an exposition of VAR methodology in IS research. This paper provides an advanced understanding of gambling behavior and helps in developing appropriate regulation to protect online gamblers and to satisfy policy makers.

The results of VAR have significant implications for both regulating and nurturing game industry. Regarding the regulation of game industry, the results of VAR indicate that the imposition of the regulation contributes in decreased playing time and significantly changes interrelationships among games. In addition, the policy impacts are different depending on user groups with different levels of prior experience. Furthermore, it significantly affects the users' behavior of changing service providers. These results means the regulatory policy has completely changed the nature of whole game industry in short time. Therefore, the policy makers should carefully consider online gamblers as a heterogeneous group to prevent effectively creating pathological gamblers as well as to protect successfully personal freedom. Furthermore, in terms of nurturing game industry, the results of our paper shows that the effect of the government policy is only negative to encourage the game industry even though the government tries to promote contents development including game contents.

However, this paper does not come without limitations. This paper investigates the regulation effect with only three theoretical perspectives: social influence, prior experience and perceived switching cost. Although these theoretical perspectives are based on prominent IS theories, there is still room for improvement. Future studies can examine regulation effect on online gambling with other interesting aspects. In addition, it uses the online game data from Korea only. It is possible to overlook cultural distinctive characteristics in different countries. Furthermore, it uses game level data instead of individual level data. To check consistency, more study is planned to obtain individual level data of each game with more investigation to strengthen the current results.

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〈Appendix〉 IRF (Impulse → Response) for Five Games

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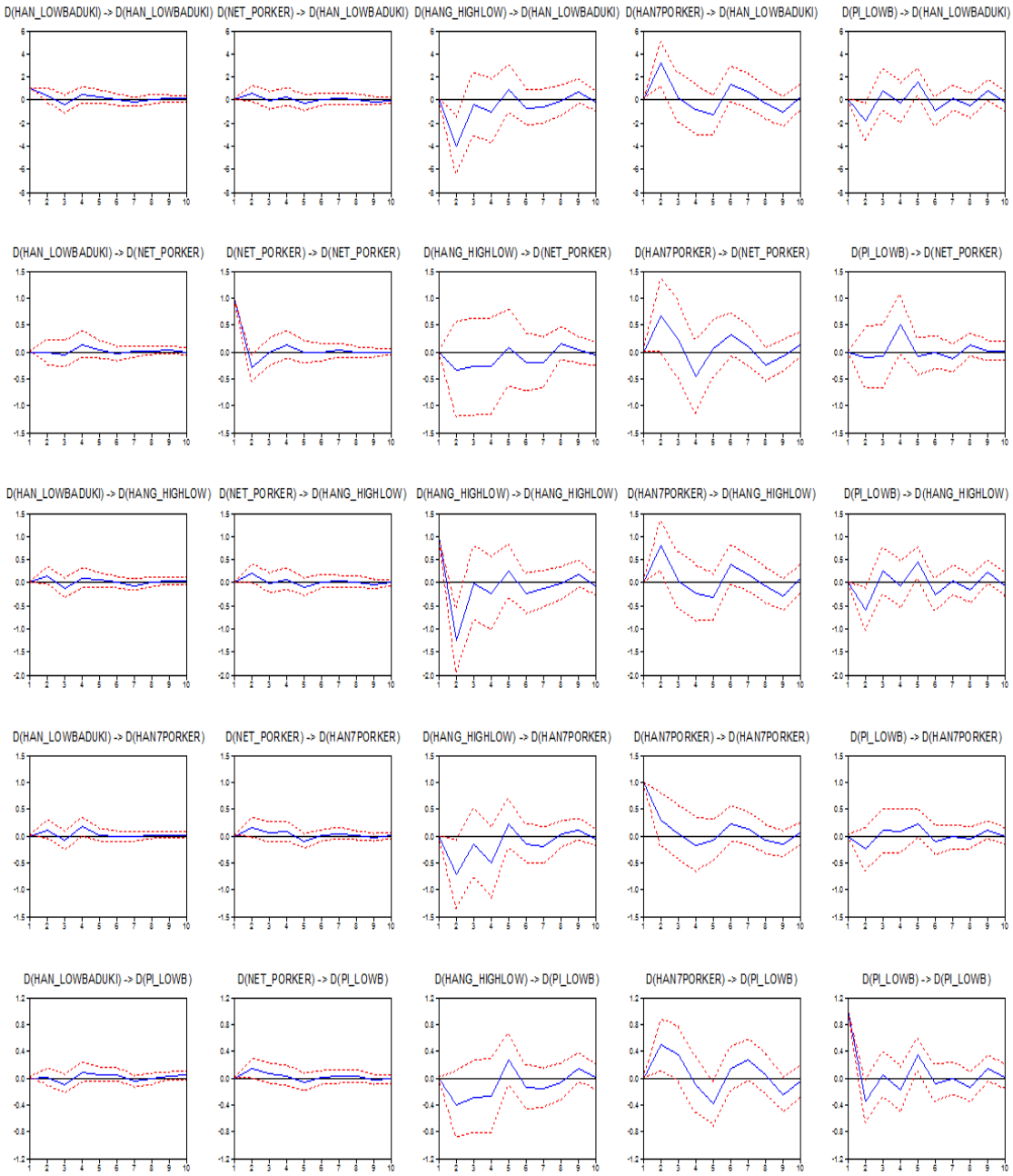

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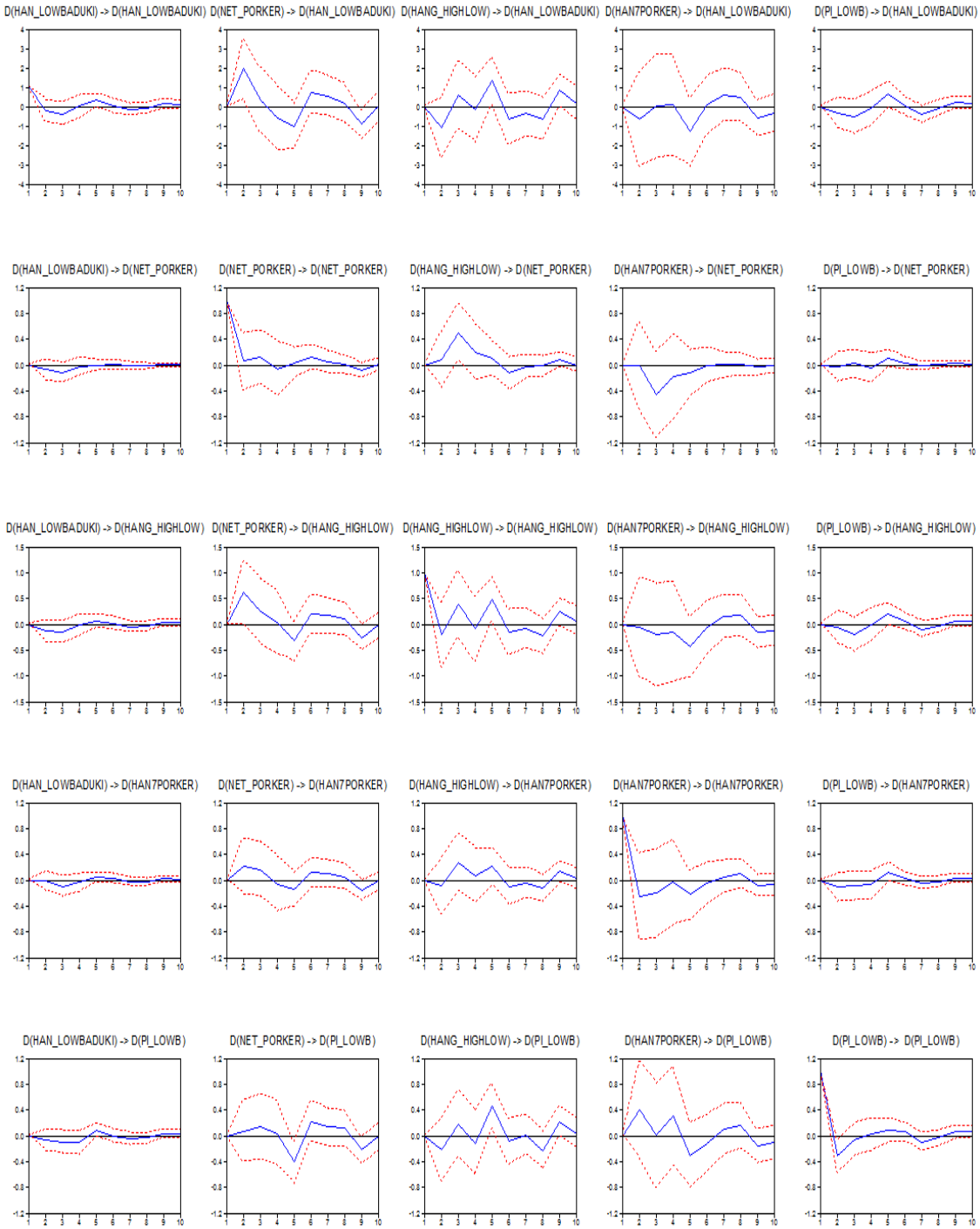
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An Empirical Study on the Effects of Regulation in Online Gaming Industry via Vector Autoregression Model

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Abstract

This study empirically examines the effects of regulation on online gaming. Going beyond ad hoc heuristic approaches on individual behavior, we investigate the effects of regulation on dynamic changes of games or service providers. In particular, we propose three theoretical perspectives: social influence to investigate the regulation effect, the role of prior experience to determine the difference in the regulation effect size through users' prior experience, and network externalities to discover the difference in the regulation effect size according to the number of users on an online gaming platform. We use the vector autoregression methodology to model patterns of the co-movement of online games and to forecast game usage. We find that online gamers are heterogeneous. Therefore, policy makers should make suitable regulations for each heterogeneous group to effectively avoid generating gaming addicts without interrupting the economic growth of the online gaming industry.

Keywords: Online Gaming, Online Gambling Games, Regulation, Policy Effect, Time Series Analysis, Vector Autoregression Model

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