경제학박사학위논문

Three Essays on Global Diversification, Structural Demand Estimation, Credit Card Interest Rate

2015년 8월

서울대학교 대학원

경제학 전공

윤 종 문

Three Essays on Global Diversification, Structural Demand Estimation, Credit Card Interest Rate

지도교수 김 소 영

이 논문을 경제학 박사학위논문으로 제출함

2015년 4월

서울대학교 대학원

경제학부 경제학 전공

윤 종 문

윤종문의 박사학위논문을 인준함

2015년 6월

위 원 장 조 성 진 (인)

부 위 원 장 김 소 영 (인)

위 원 유 병 준 (인)

위 원 이 성 훈 (인)

위 원 빈 기 범 (인)

Abstract

Three Essays on Global Diversification, Structural Demand Estimation, Credit Card Interest Rate

Yoon, Jong Mun
Department of Economics
The Graduate School
Seoul National University

This paper is composed of three essays. First essay analyzes the effectiveness of international small-cap funds on portfolio diversification by using MSCI monthly indices covering small and large-cap funds from 24 countries. We found that global integration has eroded the benefits of diversifying investments across different countries and cap-based stocks. It provides the implication to find lower correlation assets than small-cap funds on portfolio diversification.

Second essay estimates demand of online daily deal sites by using the structural demand estimation methodology such as BLP, Modified BLP, RCNL. It solves problems of IIA (Independence of Irrelevant Alternatives) and allow us to estimate demand function of individual level even though we don't have individual sales data. As a result of structural estimation, we found that sales period for online daily deal had a negative impact on total sales. a one-day extension of the sale time period will decrease the product's weekly market share by 15.1%. It could be explained by "Attention Economy" and "Search Cost."

Last essay analyzes how macroeconomic variables affect credit card interest rate. Previous studies don't have considered them even though it is possible that macroeconomic factors affect household default risk which is directly related to credit card interest rate. This paper sets up a model by adding household default risk to Stango (2002)'s switching cost model. We found that macroeconomic variables affect credit card interest rate significantly. Additionally, cost of fund, interest cap, and delinquency rate affect credit card interest rate significantly, but switching costs don't.

.....

keywords: Global Diversification, Structural Demand, Demand Estimation, Credit Card Interest Rate, BLP, Portfolio Diversification

Student Number: 2011-30075

Contents

List of Tables

List of Figures

I. Introduction

This paper is composed of three essays. First essay analyzes the effectiveness of international small-cap stocks on portfolio diversification. Second essay estimates demand of online daily deal sites such as Groupon by using the structural demand estimation methodology. Last essay analyzes how macroeconomic variables affect credit card interest rate.

Firstly, it is important to understand how capital market integrations affect global portfolio diversification from the perspectives of Korean investors. This paper analyzes it with the sharp index and the correlations of each cap-based fund, the mean-variance spanning tests for small-cap fund, and their relations with international exchange rates by using datastream's MSCI monthly indices covering small and large-cap funds from 24 countries. The main results can be summarized as follows. First, cap-based returns of both small and large-cap funds in Korea were negatively correlated with changes in the international exchange rates in major economies around the world. Second, global integration has eroded the benefits of diversifying investments across different countries, industries, and cap-based stocks. Third, Korea showed less correlation with BRICs countries than it did with developed countries or Asia, and the Sharpe ratios of BRICs countries were higher than those of other countries. Fourth, spanning tests resulted in no rejection of the null hypothesis over small-cap funds in most countries. Fifth, the Sharpe ratios of Korean investors' international fund investments were higher in the case of no-hedged risks for international exchange rate volatility than in case of fully-hedged ones. Sixth, the analysis of variance decomposition for each country's small-cap fund return showed that the influence of global factor on the return and its variance greatly increased during

the period from January 2003 to December 2010 compared to that from June 1994 to December 2002.

Secondly, Online daily deal sites such as Groupon, which have grown explosively in recent years, allow merchants to gain the attention of online consumers and thereby increase their customer base. 'Deal-of-the-day' websites, a form of electronic commerce, offer time-limited bargain deals with significant discounts—normally 50-90% off—for specific regions. Online daily deal sites send the information on deals to their subscribers via email and short messages, and consequently merchants are introduced to a number of new customers. The so-called "Groupon magic" has seen Groupon revenue grows from $15M in 2009 to $2.6B in 2013 (Marketwatch, 2014). In this paper, we use structural models to estimate demand for a large daily deals site. We find that for a voucher with an average market share, a one per cent extension in the sale period is associated with a decrease in voucher demand by 0.37%. Moreover, a one per cent increase in the price is associated with a decrease in demand by 1.42%. Furthermore, the counter-factual experiment results show that, ceteris paribus, a one-day extension of the sale time period will decrease the product's weekly market share by 15.1%. This suggests the presence of attention economy in online daily deals such that limited-time offers are likely to draw the consumers' attention and consequently lead to additional sales.

Lastly, I analyze how macroeconomic variables affect credit card interest rate such as cash advance and card loan. Previous studies don't have considered them even though it is possible that macroeconomic factors affect household default risk which is directly related to credit card interest rate. Stango (2002) made a model how credit card interest rate is determined, applying Chen (1997)'s switching cost model. This paper also sets up a model by adding

household default risk to Stango (2002)'s model and uses macroeconomic variables, household debt ratio, real GDP, and seasonal adjusted unemployment rate, as proxies of household default risk. Credit card loan is usually borrowed by low credit rating persons compared to bank loan, so it is important to predict and measure the probability of household default. By using unbalanced panel data with 21 credit card issuers, I find that macroeconomic variables affect credit card interest rate significantly. Interest rate of cash advance increases approximately 0.05%p~0.12%p as household debt ratio increases 1%p depending on models. Card loan interest rate increases approximately 0.083%p as household debt ratio increases 1%p in previous quarter. Card loan interest rate increases approximately 0.2%p as GDP increases 1%p in two-quarter lagged. Cash advance and card loan interest rate increases approximately 1.1%p as unemployment rate increases 1%p in pervious quarter, and vice versa. There are also other explanatory variables, cost of fund (card bond return rate), log credit sales (lump-sum payment), interest cap, switching costs (cash advance and card loan usage ratios), and delinquency rate. According to results, cost of fund, interest cap, and delinquency rate affect credit card interest rate significantly, but switching costs don't.

Ⅱ. The Effectiveness of International Small-cap Stocks on Portfolio Diversification[1)]

1. Introduction

Korea's fund sales outstanding grew at a compound annual growth rate of 8% from KRW 234 trillion at the end of 2006 to KRW 309 trillion at the end of 2010. This is equivalent to 30% of Korea's GDP and 27% of Korea's stock market capitalization as of the end of 2010. Together with Korea's fund industry growth, domestic investors' international fund investments grew rapidly. Especially, the Koreans government's drive for expanding overseas investments had a significant impact on the increase in international fund investments in 2007, which helped increase the percentage of international funds in overall fund sales outstanding from 8% at the end of 2006 to 21% at the end of 2010.

International portfolio diversification via international funds is commonly regarded to deliver a risk-reducing effect. Hence, the expansion of international fund investments appears beneficial for not only fund investors, but also the development of the fund industry. If the risk-reducing effect is real even during a crisis, the benefits from international diversification via international funds should receive more emphasis. On that account, international fund investments should have been expanded during the global financial crisis. However, this was not the case for Korea's fund industry: International fund investments actually reacted more sensitively than domestic fund investments to the global financial crisis. As of the end of 2010, domestic funds' sales outstanding rose approximately 10% from the end of 2007 while that

1) This paper was published in Asian Review of Financial Research Vol. 24 No. 4.

of international funds fell 13% during the same period. Notably, domestic funds' net asset value climbed around 5% from the end of 2007 to the end of 2008 while international funds' NAV halved. A possible explanation for this is that the risk-reducing effect of international diversification via international funds might have not been fully utilized. Or, another interpretation is possible: The sales of international funds could have fallen endogenously as the benefits from international diversification were mitigated by the increased exposure to Korean stocks that were less affected by the global financial crisis. This implies that investment strategies reflecting local factors, rather than global factors, may count more in the benefits from international portfolio diversification.

From the perspective of risk distribution, investing in international funds is a highly attractive strategy for Korean investors. Investment diversification theory has been first suggested by Markowitz (1959). Grubel (1968) has pioneered the study that extended the concept of portfolio diversification benefits to international capital markets to explore the benefits from international diversification via international investments. Since then, many researchers including Levy and Sarnat (1970), Lessard (1973, 1976), Solnik (1974), and Solnik and Noetzlin (1982) have studied the ex-post performance of efficient portfolios for international investments. They have proved that internationally diversified portfolios offer benefits because of the low synchronization between stock markets in different countries. However, recent studies (Longin and Soldnik, 1995; Goetzmann, Li, and Rouwenhorst, 2005; De Jong and De Roon, 2005; Carrieri, Errunza, and Hogan, 2007; Pukthuanthong-Le and Roll, 2009) have shown the progress of synchronization where the correlation among stock markets is rising. This means that the integration of global capital markets is diluting the benefits from international portfolio diversification.

Consequently, returns on stocks or funds reflect global factors more than before, weakening the international diversification effect. In order to take advantage of international diversification via international funds, investors should turn to a strategy that pursues returns from local factors with the limited exposure to the global markets, rather than focusing on global factors. More concretely, investing in markets that are less integrated in the global markets, or domestic industries and funds that have a low correlation with the national market's systemic risk would better capitalize on international diversification. In this vein, Driessen and Laeven (2007) have argued that international investments are more beneficial for investors in developing countries than those in developed countries. For the reason behind the dwindling benefits from international diversification, Eun, Huang, and Lai (2008) have pointed out that most investors try to diversify portfolios by investing in large-cap international funds that show high financial integration. Hence, according to the study, investing in international small-cap funds would fully capitalize on the benefits from international portfolio diversification. This is because investment returns on international large-cap funds are likely to be affected by the global market risk whereas small-cap funds tend to be driven by local, unsystematic factors. Lee, Lee, and Yoon (2011) have reexamined this using up-to-date data from the perspective of US investors.

Against the backdrop, this study assesses whether Korean investors, not US investors, would enjoy the risk-reducing benefit from international diversification via international small-cap and large-cap funds from major countries. Taking into account the investment strategy whose returns are primarily driven by country-specific and local factors, we focus on whether Korean investors can get additional international diversification benefits by investing in international small-cap funds as opposed to large-cap

funds. Also considered is the risk in foreign exchange rate volatility, which matters in international fund investments. With this in mind, we conduct a series of thorough analyses on the international portfolio diversification effect under two scenarios; 1) the exchange rate volatility risk is fully hedged (full-hedge), and 2) the risk is not hedged (no-hedge).

Based on Eun et. al. (2008), we obtain MSCI monthly indices from a total of 24 sample countries during the sample period and the sub-periods to analyze: small-cap fund returns and risks by country; the Sharpe index of each cap-based fund by country; the correlation among funds; the mean-variance spanning tests for small-cap funds; and the analysis on return structures and variance decomposition, in relation with foreign exchange rates.

This paper is organized as follows. Section 2 offers data sets and analyses on returns, risks, and the Sharpe index of cap-based funds from sample countries. In order to observe the pace of global synchronization, the sample period is divided into two sub-periods. Section 3 explains our model for empirical analysis, conducts the mean-variance spanning tests for small-cap funds, and decomposes the variance of their returns with fully hedged and unhedged risks during the sample period as well as the sub-periods. Last, Section 4 outlines the results and suggests the need for novel strategies that can enhance the efficiency of international portfolio diversification.

2. Data Sets and Fundamental Statistics

2.1 Data for analysis

In order to analyze the international portfolio diversification effect, we need fund returns, cap-based returns, risk-free interest rates, and foreign exchange rates in sample countries. This study uses Datastream's MSCI monthly indices of 24 sample markets for the period between June 1994 to December 2010 to analyze the returns and risks of funds from each sample country, and their correlation with domestic funds. In addition, we obtain cap-based MSCI indices that provide small-cap and large-cap indices according to market capitalization in order to compute cap-based returns[2] and carry out the mean-variance spanning tests on small-cap funds from each sample nation. Because the primary focus of this paper is on Korean investors' international fund investments, the average yield on Korea's 364-day monetary stabilization bonds (MSBs) for the sample period is used as a proxy variable for the risk-free interest rate in the Sharpe analysis. In order to assess the correlation between Korean funds' returns and foreign exchange rate volatility, and to carry out the spanning test, we use two foreign exchange rate data; the monthly average data from the Bank of Korea, and foreign exchange rates of the Korean won against other currencies from Datastream.[3] For the

---

2) In Datastream's cap-based indices, the MSCI Global Investable Market Index provides each market's large-cap, middle-cap, and small-cap indices denominated in the home currency. The large-cap index accounts for 70% of market capitalization, and the middle-cap index for 15% and the small-cap index for about 14%. Because cap-based indices are not available for China, Denmark, Finland, and France, returns on those markets are computed based on cap-based market value, which should be interpreted with caution. For Russia, MSCI index fund data are available from January 1995 while market cap-based data are available from June 1996.

3) The foreign exchange rate means the ratio at which one unit of a foreign currency is converted to the Korean won. For example, the won-dollar exchange rate of

countries without available data, we calculate them indirectly by using their exchange rates against the US dollar.

2.2 Risk-return characteristics and the Sharpe ratio

In order to analyze global portfolio diversification using international small-cap and large-cap funds from sample countries, we obtain MSCI small-cap and large-cap stock indices and compute the average return (σ), the Sharpe ratio (SHP),[4] and the correlation between MSCI indices and KOSPI returns (Corr). Because Korean investors buying international funds are exposed to the foreign exchange volatility risk, the relation between international funds and foreign exchange rate volatility may lead to different results about the effectiveness of portfolio diversification. Hence, we examine the results under full-hedge, and no-hedge scenarios.

Table 1 reports the correlation between MSCI index returns in sample countries and Korea's foreign exchange rate volatility against currencies of those countries. Except three countries including Australia, Russia, and Brazil, all countries studied are found to have a negative correlation. The result is similar in market cap-based MSCI indices: A negative correlation exists between MSCI large-cap and small-cap index returns and foreign exchange rate volatility. Given that returns on Korean funds have a positive relation with international fund returns due to global synchronization, international funds, even without hedging, have a complementary relationship with Korean funds.

1,000 means that USD 1 is converted to KRW 1,000.

4) Sharpe ratio = (Annualized fund return - Annualized risk-free return)/Annualized standard deviation of fund.

Table 1. Correlations Between MSCI Indices and Foreign Exchange Rates

The table shows the correlation between global stock indices (MSCI country indices, large-cap funds, and small-cap funds from sample countries) and exchange rates (the Korean won/the foreign currency, the conversion rate of the Korean won against currencies of sample countries). For countries without available exchange rate data, we indirectly calculate the exchange rate by using the currencies' exchange rates against the US dollar. ***, **, and * denote the 1%, 5%, and 10% significance levels, respectively.

Country	Correlation with the Korean won exchange rate		
	MSCI country index	Large-cap funds	Small-cap funds
Australia	0.03	0.02	0.08
Belgium	-0.22***	-0.20***	-0.23***
Brazil	0.05	0.08	0.07
Canada	-0.32***	-0.31***	-0.38
China	-0.03	-0.01	0.01***
Denmark	-0.23***	-0.19***	-0.25***
Finland	-0.27***	-0.20**	-0.15**
France	-0.27***	-0.29***	-0.26***
Germany	-0.27***	-0.26***	-0.26***
Hong Kong	-0.31***	-0.30***	-0.43***
India	-0.16**	-0.16***	-0.20***
Ireland	-0.23***	-0.22**	-0.17**
Italy	-0.22***	-0.23***	-0.26***
Japan	-0.39***	-0.37***	-0.26***
Netherlands	-0.26***	-0.27***	-0.29***
Norway	-0.19***	-0.18***	-0.20***
Russia	0.12*	0.06	0.09
Singapore	-0.20***	-0.12***	-0.30***
Spain	-0.21***	-0.21***	-0.24***
Sweden	-0.13*	-0.12**	-0.16**
Switzerland	-0.32***	-0.32***	-0.39***
UK	-0.28***	-0.27***	-0.29***
US	-0.35***	-0.34***	-0.33***
Average	-0.20	-0.19	-0.21

A decrease in international fund returns tends to cut Korean fund returns, but at the same time tends to increase the Korean won's exchange rate against foreign currencies. Hence, Korean investors in international funds will see a rise in their fund value converted into the Korean won when the foreign exchange rate is not hedged. On the

contrary, an increase in Korean fund returns tends to increase international fund returns, but bring down the exchange rate. Then, the value of international funds held by Korean funds, when converted into the Korean won, may fall. This implies that the benefit from international diversification via international funds (both small-cap and large-cap) becomes more evident for Korean investors when the exchange rate volatility risk is not hedged. Because the analysis on the portfolio diversification effect may produce different results depending on whether the exchange rate risk is hedged or not, we need to adopt the full-hedge and no-hedge scenarios.

2.2.1 Full-hedge scenario

Table 2 shows the Sharpe ratio (SHP) computed by using the average return (R) and risk (σ) for MSCI small-cap and large-cap index funds from sample countries under the full-hedge scenario.[5] Also included is the correlation (Corr) between the KOSPI return and MSCI small-cap and large-cap returns. The returns and the standard deviation refer to the annualized value for monthly returns and the standard deviation.[6]

The data in Table 2 demonstrate that the average return on small-cap funds (11.4%) is larger than large-cap funds (9.2%), which evidences market risk premiums of small-cap funds across countries. In six countries including Denmark, Germany, Hong Kong, Japan, Korea, and Norway, large-cap fund returns are higher than those of small-cap funds. Small-cap funds in the rest 18 countries in our sample are found to have returns higher than those of large-cap

5) Full-hedge in this paper means that the exchange rate risk is 100% hedged in order to completely eliminate the exchange rate volatility risk.

6) An annualized return means $((1+monthly\ return)^{12}-1))$ and annualized standard deviation is$(monthly\ standard\ deviation * \sqrt{12})$.

funds. The average standard deviation of returns in all sample countries is slightly larger in small-cap funds (25.4%) than large-cap funds (24.8%), but the difference is insignificant.

In detail, the returns and standard deviation of BRICs countries (Brazil, Russia, India, and China) are far higher than those of other sample countries, and this applies to both small-cap and large-cap funds. The trend is especially pronounced in Brazil and Russia. On the other hand, Asian countries show similar returns to developed countries for both small-cap and large-cap funds, but their standard deviation is slightly higher than developed countries. Especially, the standard deviation of returns is lower in Australia, the UK, the US, Switzerland, and Canada (ascending order). The standard deviation of the US is slightly higher than that of the UK seemingly due to the rising risk in the US capital markets in the aftermath of the global financial crisis.

Korea's capital markets show interesting aspects about small-cap funds: Small-cap funds tend to have lower returns and higher risks (standard deviation of returns). A comparison with developed countries shows that large-cap funds have larger returns and higher standard deviation of returns than the average in developed countries, whereas small-cap funds have lower returns and higher standard deviation of returns than the average in developed countries. This suggests that there are no market risk premiums for small-cap funds in Korea.

The correlation between market cap-based MSCI indices from sample countries and Korea's stock index (KOSPI) is found to be higher in large-cap funds, rather than small-cap funds, although the difference is insignificant. Also, Korea's correlation with BRICs is similar across small-cap and large-cap funds, but generally lower than that with non-BRICs countries. This indicates that Korea is less synchronized with BRICs economies than developed economies or

Asian countries.

The Sharpe ratio is a measure indicating the rate of returns relative to risks. The average for sample countries stands at 0.13 for small-cap funds, higher than 0.04 for large-cap funds. This is because small-cap fund returns are higher than those of large-cap funds while their standard deviation is almost the same. Hence, if transaction costs are equal, investments in international small-cap funds can be more attractive compared to large-cap funds. BRICs countries show an overwhelmingly higher Sharpe ratio than other countries, meaning that investments in BRICs countries are more attractive compared to other countries. Although Korea's Sharpe ratio for large-cap funds is above the average, the ratio for small-cap funds is substantially lower than other sample countries.

Also notable is that the Sharpe ratios of Asian countries for both large-cap and small-cap funds except Korea are far lower than the BRICs average and the overall average. This stems from the low returns relative to risks in countries such as Japan and Hong Kong. Furthermore, in terms of the correlation with KOSPI, the Asian average is higher than the BRICs average for both large-cap and small-cap funds. This suggests the possibility where Korean investors' international fund holdings are weighted towards the Asian Continent and thus fail to reflect the benefit from international portfolio diversification.

Table 2. Return and Risk Characteristics (full-hedge)

This table shows the returns (R) and risks (σ) of funds from sample countries under the full-hedge scenario. We use the average returns on Korea's 364-day MSBs for risk-free returns in the Sharpe ratio (SHP). The correlation (Corr) means the correlation between the MSCI return from each sample country and the KOSPI return. The Asian average refers to the average of China, Hong Kong, India, Japan and Singapore, while the BRICs average represents the average of Brazil, Russia, India and China. ***, **, and * denote the 1%, 5%, and 10% significance levels, respectively.

Country	Large-cap funds				Small-cap funds			
	R	σ	SHP	Corr	R	σ	SHP	Corr
Australia	6.7%	13.5%	-0.03	0.48***	7.1%	16.2%	0.00	0.45***
Belgium	2.8%	22.4%	-0.19	0.33***	4.3%	17.3%	-0.16	0.29***
Brazil	24.7%	32.2%	0.55	0.35***	26.9%	28.9%	0.69	0.33***
Canada	9.2%	16.6%	0.13	0.44***	11.9%	17.8%	0.27	0.42***
China	13.4%	46.8%	0.14	0.28***	13.5%	37.3%	0.17	0.32***
Denmark	13.6%	27.4%	0.24	0.31***	10.0%	20.2%	0.14	0.36***
Finland	5.9%	28.3%	-0.04	0.34***	12.2%	20.6%	0.25	0.35***
France	7.2%	20.7%	0.00	0.40***	9.7%	18.4%	0.14	0.43***
Germany	7.0%	21.8%	0.00	0.40***	1.8%	22.4%	-0.24	0.37***
Hong Kong	7.9%	26.1%	0.03	0.45***	6.4%	32.4%	-0.02	0.37***
India	13.9%	29.5%	0.23	0.34***	15.0%	32.6%	0.24	0.32***
Ireland	2.0%	25.3%	-0.20	0.32***	15.7%	27.5%	0.31	0.36***
Italy	3.6%	21.9%	-0.16	0.38***	6.5%	23.1%	-0.03	0.35***
Japan	-1.8%	18.5%	-0.48	0.50***	-2.6%	22.5%	-0.43	0.48***
Netherlands	11.2%	32.9%	0.12	0.95***	8.3%	36.0%	0.03	0.90***
Norway	6.5%	19.5%	-0.03	0.42***	7.0%	20.7%	0.00	0.44***
Russia	9.9%	23.5%	0.12	0.37***	9.4%	25.5%	0.09	0.40***
Singapore	31.7%	51.0%	0.48	0.30***	48.6%	56.8%	0.73	0.30***
Spain	3.4%	23.1%	-0.16	0.47***	8.5%	31.1%	0.05	0.45***
Sweden	9.8%	22.9%	0.12	0.43***	9.8%	20.0%	0.13	0.36***
Switzerland	11.9%	25.5%	0.19	0.41***	13.5%	21.5%	0.30	0.41***
UK	6.9%	16.0%	-0.01	0.37***	9.9%	19.7%	0.14	0.42***
US	5.1%	14.3%	-0.14	0.47***	7.5%	19.0%	0.02	0.47***
Korea	7.3%	15.9%	0.01	0.47***	12.0%	21.1%	0.23	0.42***
Asian average	7.4%	28.8%	-0.05	0.41	8.2%	31.2%	0.00	0.39
BRICs average	20.9%	39.9%	0.35	0.32	26.0%	38.9%	0.46	0.32
Non-BRICs average	6.8%	21.8%	-0.02	0.43	8.4%	22.7%	0.06	0.43
Average	9.2%	24.8%	0.04	0.42	11.4%	25.4%	0.13	0.41

2.2.2 No-hedge scenario

Table 3 represents the returns, risks, and Sharpe ratios assuming that the exchange rate risk inherent in international fund investments is not hedged. This analysis is considered as a more realistic picture about the cap-based portfolio diversification effect. Table 1 shows a negative correlation between the returns on MSCI country indices and exchange rates. This implies that when Korean investors invest in international funds, the effect of cap-based portfolio diversification by the measure of returns relative to risks grows larger when the exchange rate risk is not hedged. Given that, we adopt the no-hedge scenario. The overall results are similar to those under the full-hedge scenario.

However, there are differences between the two scenarios. Under the no-hedge scenario, large-cap and small-cap fund returns tend to rise, and their correlation with KOSPI falls compared to the full-hedge scenario. Furthermore, the average of all sample countries shows that when the exchange rate risk is not hedged the Sharpe ratios of international large-cap and small-cap funds stand at 0.15 and 0.23, respectively, that are far higher than 0.04 and 0.13 for fully hedged international funds. This confirms the aforementioned result: Large-cap and small-cap funds have larger returns relative to risks when Korean investors purchase international funds without hedging the exchange rate risk, which enhances the international portfolio diversification effect.

Table 3. Return and Risk Characteristics (no-hedge)

This table indicates the returns (R) and risks (σ) of funds from sample countries under the no-hedge scenario. We use the average returns on Korea's 364-day MSBs for risk-free returns in the Sharpe ratio (SHP). The correlation (Corr) means the correlation between the MSCI return from each sample country and the KOSPI return. The Asian average refers to the average of China, Hong Kong, India, Japan and Singapore, while the BRICs average represents the average of Brazil, Russia, India and China. ***, **, and * denote the 1%, 5%, and 10% significance levels, respectively.

Country	Large-cap funds				Small-cap funds			
	R	σ	SHP	Corr	R	σ	SHP	Corr
Australia	12.3%	20.3%	0.26	0.42***	12.9%	22.7%	0.25	0.42***
Belgium	6.3%	24.8%	-0.03	0.21***	7.9%	20.4%	0.04	0.14*
Brazil	20.5%	39.0%	0.34	0.36***	22.4%	36.0%	0.42	0.34***
Canada	13.6%	18.3%	0.36	0.20***	16.2%	18.5%	0.49	0.22***
China	11.4%	46.8%	0.09	0.28***	11.5%	37.5%	0.12	0.32***
Denmark	17.4%	28.9%	0.36	0.22***	13.6%	22.3%	0.29	0.23***
Finland	9.3%	29.5%	0.07	0.25***	16.2%	24.0%	0.38	0.21***
France	10.5%	22.3%	0.15	0.28***	13.3%	20.9%	0.30	0.27***
Germany	10.4%	23.4%	0.14	0.28***	4.9%	23.6%	-0.09	0.26***
Hong Kong	10.0%	25.9%	0.11	0.34***	7.5%	29.6%	0.01	0.31***
India	13.6%	30.5%	0.21	0.28***	14.5%	32.9%	0.23	0.28***
Ireland	5.3%	26.9%	-0.07	0.22***	19.5%	29.5%	0.42	0.26***
Italy	7.0%	24.1%	0.00	0.26***	9.8%	24.6%	0.11	0.25***
Japan	2.0%	20.0%	-0.26	0.42***	1.4%	25.1%	-0.23	0.42***
Netherlands	11.2%	32.9%	0.12	0.95***	8.3%	36.0%	0.03	0.90***
Norway	10.0%	21.5%	0.13	0.28***	10.3%	22.0%	0.15	0.31***
Russia	14.0%	25.4%	0.27	0.29***	13.4%	26.8%	0.23	0.33***
Singapore	23.0%	54.3%	0.29	0.22***	39.5%	57.2%	0.57	0.25***
Spain	7.2%	24.9%	0.00	0.37***	11.6%	30.1%	0.15	0.41***
Sweden	13.4%	25.2%	0.25	0.30***	13.4%	22.4%	0.28	0.23***
Switzerland	15.8%	28.0%	0.31	0.34***	17.4%	24.2%	0.43	0.32***
UK	12.3%	19.1%	0.27	0.17**	15.0%	20.5%	0.39	0.28***
US	8.1%	18.4%	0.06	0.20***	10.3%	20.9%	0.15	0.28***
Korea	9.8%	17.8%	0.15	0.27***	14.4%	21.6%	0.34	0.29***
Asian average	8.8%	29.6%	0.03	0.34	9.3%	31.0%	0.06	0.35
BRICs average	17.1%	42.6%	0.24	0.29	22.0%	40.9%	0.33	0.30
Non-BRICs average	10.3%	23.9%	0.13	0.31	11.9%	24.3%	0.21	0.32
Average	11.4%	27.0%	0.15	0.31	13.6%	27.1%	0.23	0.31

2.3 Correlations with international funds

2.3.1 Full-hedge scenario

Table 4 takes a more detailed look at the correlation between Korea's and sample countries' small-cap and large-cap funds for the sample period and the sub-periods. During the sample period, the average correlation between funds from Korea and from the rest 23 sample countries is slightly larger for large-cap funds (0.38) than for small-cap funds (0.36). Although the correlation with BRICs countries barely shows difference across large-cap and small-cap funds, the average correlation with BRICs countries is lower in all funds during the sample period, compared to the average correlation with all sample countries. In order to look at the pace of global synchronization, we divide the sample period into two sub-periods; eight years before and after 2003. Overall, the correlation between large-cap funds is larger than that between small-cap funds. Also found is the rapid deepening of global synchronization. For the first sub-period (June 1994-December 2002), the average correlation between Korean small-cap funds with those of 23 sample countries is 0.26 while the figure for large-cap funds is 0.30. However, a steep rise is observed during the second sub-period (January 2003-April 2010); 0.57 for small-cap funds and 0.60 for large-cap funds.

The deepening of global synchronization makes the correlation between cap-based funds from Korea and other sample countries higher than that shown in Eun et al. (2008). Also confirmed is that the correlation between small-cap funds from Korea and from sample countries is not significantly lower than that for large-cap funds. In addition, the impact of global synchronization is found to have deepened as time passes by.

Table 4. Correlations Between Cap-based Funds from Korea and Sample Countries (full-hedge)

This table explores the correlation between cap-based funds from Korea and other sample countries for the sample period and the sub-periods under the full-hedge scenario. We look at the significance based on the null hypothesis that the correlation is zero for the sample period consisting of the first sub-period (eight years before 2003) and the second sub-period (eight years after 2003). ***, **, and * denote the 1%, 5%, and 10% significance levels, respectively.

Country	Cap-based funds	Korea					
		Sample period		1st sub-period		2nd sub-period	
		Small-cap	Large-cap	Small-cap	Large-cap	Small-cap	Large-cap
Australia	Small-cap	0.40***	0.42***	0.30***	0.32***	0.60***	0.67***
	Large-cap	0.40***	0.47***	0.37***	0.42***	0.50***	0.62***
Belgium	Small-cap	0.28***	0.27***	0.12	0.11	0.55***	0.58***
	Large-cap	0.28***	0.32***	0.11	0.19*	0.55***	0.60***
Brazil	Small-cap	0.34***	0.29***	0.19*	0.18*	0.62***	0.56***
	Large-cap	0.32***	0.33***	0.21**	0.25**	0.59***	0.58***
Canada	Small-cap	0.39***	0.39***	0.29***	0.30***	0.58***	0.60***
	Large-cap	0.37***	0.42***	0.27***	0.34***	0.59***	0.63***
China	Small-cap	0.31***	0.28***	0.18*	0.17*	0.60***	0.56***
	Large-cap	0.27***	0.22***	0.17*	0.13	0.59***	0.55***
Denmark	Small-cap	0.35***	0.33***	0.21**	0.13	0.58***	0.66***
	Large-cap	0.28***	0.30***	0.16	0.20**	0.48***	0.53***
Finland	Small-cap	0.30***	0.35***	0.20**	0.24**	0.49***	0.58***
	Large-cap	0.26***	0.33***	0.19*	0.27***	0.43***	0.49***
France	Small-cap	0.39***	0.41***	0.24**	0.28***	0.63***	0.71***
	Large-cap	0.34***	0.40***	0.24**	0.28***	0.58***	0.70***
Germany	Small-cap	0.38***	0.35***	0.25***	0.20**	0.61***	0.67***
	Large-cap	0.35***	0.41***	0.24**	0.28***	0.60***	0.72***
Hong_Kong	Small-cap	0.34***	0.35***	0.23**	0.26***	0.58***	0.57***
	Large-cap	0.36***	0.44***	0.28***	0.38***	0.56***	0.61***
India	Small-cap	0.28***	0.31***	0.10	0.23**	0.56***	0.51***
	Large-cap	0.32***	0.33***	0.19*	0.24**	0.58***	0.56***
Ireland	Small-cap	0.34***	0.34***	0.32***	0.30***	0.45***	0.51***
	Large-cap	0.26***	0.32***	0.23**	0.26***	0.38***	0.49***
Italy	Small-cap	0.34***	0.31***	0.24**	0.22**	0.57***	0.58***
	Large-cap	0.34***	0.37***	0.24**	0.28***	0.57***	0.62***
Japan	Small-cap	0.46***	0.43***	0.45***	0.39***	0.48***	0.54***
	Large-cap	0.44***	0.47***	0.39***	0.44***	0.56***	0.60***
Netherlands	Small-cap	0.41***	0.41***	0.30***	0.27***	0.62***	0.72***
	Large-cap	0.38***	0.41***	0.29***	0.30***	0.58***	0.70***
Norway	Small-cap	0.35***	0.39***	0.27***	0.31***	0.50***	0.59***
	Large-cap	0.33***	0.35***	0.23**	0.24**	0.52***	0.59***
Russia	Small-cap	0.27***	0.28***	0.18	0.21*	0.52***	0.51***
	Large-cap	0.27***	0.28***	0.17	0.19*	0.58***	0.58***
Singapore	Small-cap	0.45***	0.38***	0.39***	0.31***	0.57***	0.57***
	Large-cap	0.44***	0.42***	0.36***	0.33***	0.60***	0.66***

Spain	Small-cap	0.34***	0.35***	0.25**	0.26***	0.53***	0.56***
	Large-cap	0.37***	0.43***	0.29***	0.36***	0.58***	0.63***
Sweden	Small-cap	0.41***	0.38***	0.31***	0.26***	0.61***	0.64***
	Large-cap	0.37***	0.41***	0.31***	0.35***	0.52***	0.58***
Switzerland	Small-cap	0.38***	0.40***	0.26***	0.27***	0.58***	0.69***
	Large-cap	0.28***	0.38***	0.21**	0.29***	0.46***	0.62***
UK	Small-cap	0.43***	0.44***	0.32***	0.35***	0.65***	0.67***
	Large-cap	0.40***	0.46***	0.33***	0.42***	0.55***	0.60***
US	Small-cap	0.36***	0.43***	0.27***	0.34***	0.57***	0.67***
	Large-cap	0.40***	0.45***	0.34***	0.38***	0.56***	0.65***
BRICs average	Small-cap	0.30	0.29	0.16	0.20	0.58	0.53
	Large-cap	0.29	0.29	0.18	0.20	0.59	0.57
Average	Small-cap	0.36	0.36	0.26	0.26	0.57	0.60
	Large-cap	0.34	0.38	0.25	0.30	0.54	0.60

2.3.2 No-hedge scenario

As shown in Table 5, the average correlation between small-cap funds from Korea and from 23 sample countries stands at 0.22 while the figure for large-cap funds is 0.33 under the no-hedge scenario. As is in the full-hedge scenario, the correlation is higher in large-cap funds than in small-cap funds, but the absolute level is far lower. The similar result is found in the correlation with BRICs countries.

The overall sample period is divided into two sub-periods in order to look at the pace of global synchronization. Under the no-hedge scenario, global synchronization is found to have recently deepened. Also notable is that the correlation between small-cap funds from Korea and 23 sample countries for the first sub-period fails to reject the null hypothesis at the 5% significance level, except for Japan and Singapore. On the other hand, the correlation between Korea and 23 sample countries shows similar significance levels for the second sub-period. The result observed during the first sub-period is similar to that of Eun et al. (2008), whose sample period is from 1980 to 1999. Given that, the synchronization among small-cap funds seems to have progressed rapidly since the 2000s.

Table 5. Correlations Between Cap-based Funds from Korea and Sample Countries (no-hedge)

This table explores the correlation between cap-based funds from Korea and other sample countries for the sample period and the sub-periods under the no-hedge scenario. We look at the significance based on the null hypothesis that the correlation is zero for the sample period consisting of the first sub-period (eight years before 2003) and the second sub-period (eight years after 2003). ***, **, and * denote the 1%, 5%, and 10% significance levels, respectively.

Country	Cap-based funds	Korea					
		Sample period		1st sub-period		2nd sub-period	
		Small-cap	Large-cap	Small-cap	Large-cap	Small-cap	Large-cap
Australia	Small-cap	0.32***	0.44***	0.18*	0.39***	0.59***	0.59***
	Large-cap	0.31***	0.47***	0.23**	0.46***	0.49***	0.51***
Belgium	Small-cap	0.07	0.20***	-0.14	0.12	0.44***	0.39***
	Large-cap	0.11	0.27***	-0.11	0.18*	0.49***	0.48***
Brazil	Small-cap	0.30***	0.34***	0.15	0.28***	0.56***	0.49***
	Large-cap	0.29***	0.37***	0.18*	0.32***	0.54***	0.50***
Canada	Small-cap	0.14*	0.26***	0.01	0.21**	0.41***	0.40***
	Large-cap	0.09	0.27***	0.02	0.27***	0.28***	0.30***
China	Small-cap	0.31***	0.28***	0.18*	0.17*	0.60***	0.56***
	Large-cap	0.27***	0.22***	0.17*	0.13	0.59***	0.54***
Denmark	Small-cap	0.17**	0.28***	-0.08	0.15	0.54***	0.55***
	Large-cap	0.14*	0.27***	-0.03	0.21**	0.45***	0.43***
Finland	Small-cap	0.12	0.28***	-0.04	0.22**	0.42***	0.42***
	Large-cap	0.13*	0.30***	0.03	0.27***	0.38***	0.38***
France	Small-cap	0.17**	0.34***	-0.05	0.24**	0.57***	0.56***
	Large-cap	0.16**	0.35***	0.02	0.29***	0.49***	0.51***
Germany	Small-cap	0.22***	0.31***	0.04	0.21**	0.55***	0.53***
	Large-cap	0.18**	0.35***	0.03	0.28***	0.53***	0.55***
Hong_Kong	Small-cap	0.24***	0.33***	0.12	0.27***	0.53***	0.48***
	Large-cap	0.22***	0.39***	0.15	0.38***	0.41***	0.43***
India	Small-cap	0.21***	0.31***	0.01	0.26***	0.52***	0.44***
	Large-cap	0.23***	0.32***	0.09	0.26***	0.51***	0.47***
Ireland	Small-cap	0.20***	0.31***	0.09	0.28***	0.41***	0.41***
	Large-cap	0.12*	0.28***	0.02	0.24**	0.35***	0.41***
Italy	Small-cap	0.18**	0.29***	0.05	0.25**	0.49***	0.41***
	Large-cap	0.16**	0.33***	0.04	0.30***	0.46***	0.42***
Japan	Small-cap	0.33***	0.44***	0.37***	0.50***	0.20*	0.24**
	Large-cap	0.28***	0.49***	0.26***	0.54***	0.31***	0.36***
Netherlands	Small-cap	0.23***	0.36***	0.05	0.27***	0.56***	0.59***
	Large-cap	0.18**	0.34***	0.05	0.29***	0.49***	0.51***
Norway	Small-cap	0.25***	0.36***	0.13	0.32***	0.44***	0.49***
	Large-cap	0.22***	0.31***	0.08	0.24**	0.44***	0.47***
Russia	Small-cap	0.19**	0.26***	0.09	0.20*	0.45***	0.43***
	Large-cap	0.16**	0.25***	0.05	0.17	0.50***	0.49***
Singapore	Small-cap	0.37***	0.38***	0.31***	0.34***	0.53***	0.51***
	Large-cap	0.29***	0.38***	0.21**	0.33***	0.50***	0.53***

Spain	Small-cap	0.15**	0.29***	0.01	0.27***	0.43***	0.38***
	Large-cap	0.20***	0.37***	0.10	0.37***	0.45***	0.42***
Sweden	Small-cap	0.26***	0.37***	0.11	0.30***	0.53***	0.54***
	Large-cap	0.24***	0.40***	0.17*	0.38***	0.44***	0.47***
Switzerland	Small-cap	0.16**	0.35***	0.01	0.30***	0.44***	0.49***
	Large-cap	0.01	0.27***	-0.05	0.27***	0.22**	0.29***
UK	Small-cap	0.20***	0.33***	0.04	0.28***	0.49***	0.46***
	Large-cap	0.09	0.29***	0.00	0.28***	0.33***	0.33***
US	Small-cap	0.18***	0.38***	0.09	0.33***	0.42***	0.52***
	Large-cap	0.14**	0.35***	0.10	0.35***	0.30***	0.37***
BRICs Average	Small-cap	0.25	0.30	0.11	0.23	0.53	0.48
	Large-cap	0.24	0.29	0.12	0.22	0.53	0.50
Average	Small-cap	0.22	0.33	0.08	0.27	0.48	0.47
	Large-cap	0.18	0.33	0.08	0.30	0.43	0.44

3. Empirical Analysis

3.1 Model

It is true that the correlation among small-cap funds is smaller compared to large-cap funds. But whether it is beneficial for Korean investors to invest in international small-cap funds, rather than international large-cap stocks or index funds, for the benefit from international portfolio diversification or not requires further testing. If investing in small-cap funds produces no additional international diversification benefits compared to investing in large-cap stocks or index funds, investments in small-cap funds would be unnecessary. The spanning test presented by Huberman and Kandel (1987) is useful to test small-cap funds' additional benefits from international portfolio diversification. This involves the regression of small-cap fund returns of each nation on the benchmark asset returns of each nation in order to test if the fund return beats the market return. By using each nation's MSCI country index as a variable representing each nation's benchmark assets, the regression equation is:

$$R_i = \alpha_i + \sum_{j=1}^{K} \beta_{ij} MSCI_j + \epsilon_i \quad (1)$$

where R_i is the small-cap return of country i, $MSCI_j$ denotes the MSCI country index return of country j, and $\epsilon_i \sim iid(0, \sigma^2)$. The null hypothesis of spanning is that no return beats the market return of each country, which is expressed as follows:

$$H_0 : \alpha_i = 0 \text{ and } \sum_{j=1}^{K} \beta_{ij} = 1 \quad (2)$$

When T is the number of observations, K is the number of benchmark countries. Hence, the test statistic follows an F distribution with (2,T-K-1) degree of freedom. Through this, we perform an F-test for the spanning test. If the F statistic is larger than the given degree of freedom and the threshold under a certain significance level to reject the null hypothesis, it means that the sample countries' small-cap fund return beats their market return, which evidences the benefit from international portfolio diversification through international small-cap funds. On the contrary, the F statistic is smaller than the given degree of freedom and the threshold under a certain significance level to fail to reject the null hypothesis, it means that no small-cap fund return outperforms the market return.

3.2 Mean-variance spanning test: Small-cap funds

3.2.1 Full-hedge scenario

Table 6 indicates the results of the mean-variance spanning test for small-cap funds from 24 sample countries including Korea.[7] The results in most countries fail to reject the null hypothesis shown in Equation (2). In particular, this tendency is more evident in the second sub-period than the first sub-period. For the whole sample period, the null hypothesis is rejected only in three countries (Belgium, Canada, and Finland) at the 5% significance level. At the 10% significant level, only two additional countries (Ireland and Russia) reject the null hypothesis. While ten countries (Australia, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Russia and Spain) reject the null hypothesis at the 5% significance level during the first sub-period, only five countries (Denmark, France, Germany, Norway, and Russia) reject the null hypothesis at the 5% significance level during the second sub-period. The failure in most sample countries to reject the null hypothesis of the spanning test implies that investors cannot enjoy additional benefits from international portfolio diversification via international small-cap funds compared to international index funds. The fact that the tendency is more evident during the second sub-period than the first sub-period suggests that the additional benefits that can be obtained by investing in international small-cap funds are decreasing.

Also noteworthy is that small-cap funds in almost all countries have an insignificant beta with respect to foreign market indices.

---

7) We did not perform the spanning test for large-cap funds because large-cap funds in one country have a significantly high correlation with the country's index funds, which makes the spanning test ineffective.

Rather, they have a positive beta with respect to their home country market index at the 1% significant level. But small-cap fund returns in few countries are found to have a statistically significant relationship with Korea's index fund returns. During the whole sample period, small-cap funds in Japan have a significant and positive beta with respect to Korea's index fund returns at the 1% significance level, while Hong Kong has a significant and negative beta at the 1% significance level. No countries except for the two have a significant beta against Korea's index fund returns. During the first sub-period, only Japan has a significant and positive beta at the 1% significance level while the Netherlands, Singapore, and Japan have a significant beta at the 5% significance level during the second sub-period. We also look at small cap funds' alphas, meaning a significant excess return. During the whole sample period, small-cap funds from Canada, Ireland, and Russia have a significant alpha against their market at the 5% significance level. But in the second sub-period, Russia is the only country whose small-cap funds have a significant alpha at the 5% significance level. This is the indication that investors seeking international portfolio diversification have less additional benefits from investing in small-cap funds from foreign countries as time passes by.

Table 6. Spanning Test Results (full-hedge)

This table reports the spanning test results under the full-hedge scenario through the following regression equation:

$$R_i = \alpha_i + \sum_{j=1}^{K} \beta_{ij} MSCI_j + \epsilon_i,$$

where R_i denotes the small-cap fund return in country i, $MSCI_j$ denotes the MSCI country index return in country j, and $\epsilon_i \sim iid(0, \sigma^2)$. F-Stat reports the test statistic for the null hypothesis (H_0 : $\alpha = 0$ and $\sum_{j=1}^{K} \beta_{ij} = 1$), and β_{iKorea} is a beta of small-cap funds from each sample country against Korea's MSCI index return. ***, **, and * denote the 1%, 5%, and 10% significance levels, respectively.

Panel A: Overall sample period (June 1994-December 2010)

Country	α_i	β_i	β_{iKorea}	$\sum_{j=1}^{K} \beta_{ij}$	F-Stat	P-Value	R^2	Obs
Australia	0.002	0.75***	0.00	1.07	1.46	0.24	0.750	192
Belgium	-0.001	0.41***	-0.04	0.81	3.75	0.03**	0.720	192
Brazil	0.005	0.39***	-0.03	0.88	1.53	0.22	0.697	192
Canada	0.005**	0.53***	0.01	0.87	3.87	0.02**	0.737	192
China	0.007*	0.78***	-0.06	0.95	1.85	0.16	0.847	192
Denmark	0.003	0.51***	-0.02	0.98	0.61	0.55	0.719	192
Finland	0.006*	0.03	0.00	0.79	3.55	0.03**	0.612	192
France	0.004*	0.34***	0.03	0.93	2.26	0.11	0.757	192
Germany	-0.005	0.54***	0.01	0.92	1.77	0.17	0.724	192
Hong Kong	0.000	0.49***	-0.11***	1.07	0.20	0.82	0.811	192
India	0.002	0.99***	0.03	1.05	0.31	0.73	0.812	192
Ireland	0.010**	0.55***	0.01	1.08	2.51	0.09*	0.542	192
Italy	0.003	0.82***	0.00	0.98	0.85	0.43	0.787	192
Japan	0.002	1.11***	0.16***	0.87	1.17	0.31	0.724	192
Netherlands	0.000	0.30***	0.03	0.92	0.55	0.58	0.776	192
Norway	0.000	0.76***	0.02	1.03	0.06	0.94	0.778	192
Russia	0.018**	0.79***	0.01	0.91	2.46	0.09*	0.696	175
Singapore	0.003	0.91***	-0.02	1.02	0.44	0.65	0.861	192
Spain	0.003	0.47***	-0.01	0.92	1.21	0.30	0.752	192
Sweden	0.004*	0.49***	0.00	0.88	2.22	0.11	0.754	192
Switzerland	0.003	0.26***	0.00	0.99	0.69	0.50	0.792	192
UK	0.002	0.56***	0.02	1.06	0.90	0.41	0.739	192
US	0.004	0.42***	-0.03	1.04	1.21	0.30	0.735	192
Korea	-0.005	0.89***	0.89***	0.88	1.03	0.36	0.747	192

Panel B: First sub-period (June 1994-December 2002)

Country	α_i	β_i	β_{iKorea}	$\sum_{j=1}^{K}\beta_{ij}$	F-Stat	P-Value	R^2	Obs
Australia	0.004	0.62***	0.02	0.78	3.13	0.05**	0.664	96
Belgium	-0.005	0.28**	-0.03	0.67	4.33	0.02**	0.690	96
Brazil	0.000	0.40***	-0.01	0.61	1.75	0.18	0.704	96
Canada	0.006*	0.50***	0.03	0.68	4.59	0.01**	0.672	96
China	0.006	0.79***	-0.02	0.69	1.50	0.23	0.868	96
Denmark	0.001	0.32***	0.02	0.42	10.66	0.00***	0.615	96
Finland	0.007	0.01	0.03	0.50	5.29	0.01***	0.537	96
France	0.005	0.29**	0.05	0.58	7.70	0.00***	0.705	96
Germany	-0.015***	0.65***	0.04	0.45	9.59	0.00***	0.717	96
Hong Kong	-0.001	0.44***	-0.09*	0.94	0.04	0.96	0.821	96
India	0.000	0.92***	0.07	0.77	0.63	0.54	0.773	96
Ireland	0.014***	0.86***	0.06	0.63	8.66	0.00***	0.757	96
Italy	0.006	0.97***	0.02	0.78	1.79	0.17	0.796	96
Japan	0.001	1.09***	0.19***	0.73	0.88	0.42	0.696	96
Netherlands	-0.001	0.59***	0.04	0.71	1.97	0.15	0.760	96
Norway	-0.007	0.73***	0.08*	0.74	2.54	0.09*	0.785	96
Russia	0.031*	0.78***	0.19	0.00	3.64	0.03**	0.754	79
Singapore	0.000	0.82***	0.03	0.85	0.31	0.73	0.874	96
Spain	0.002	0.48***	0.04	0.66	3.04	0.05*	0.764	96
Sweden	0.004	0.46***	0.02	0.55	4.64	0.01**	0.746	96
Switzerland	0.001	0.35***	0.02	0.73	2.65	0.08*	0.839	96
UK	0.004	0.72***	0.00	1.14	1.03	0.36	0.754	96
US	0.007	-0.13	-0.04	0.93	1.32	0.28	0.723	96
Korea	-0.012	0.90***	0.90***	0.64	1.52	0.23	0.762	96

Panel C: Second sub-period (January 2003-December 2010)

Country	α_i	β_i	β_{iKorea}	$\sum_{j=1}^{K}\beta_{ij}$	F-Stat	P-Value	R^2	Obs
Australia	0.001	0.81***	0.03	1.16	2.13	0.13	0.905	96
Belgium	0.005	0.41***	-0.08	0.95	1.36	0.26	0.851	96
Brazil	0.006	0.69***	-0.12	1.24	2.41	0.10*	0.798	96
Canada	0.000	0.78***	0.00	1.05	0.16	0.85	0.861	96
China	0.005	0.68***	0.08	1.02	0.65	0.53	0.880	96
Denmark	0.005	0.46***	0.04	1.25	4.28	0.02**	0.897	96
Finland	0.007	0.04	-0.03	1.00	1.27	0.29	0.805	96
France	0.006*	0.42	0.13*	1.20	4.98	0.01***	0.890	96
Germany	0.005	0.53***	-0.01	1.20	3.23	0.05**	0.868	96
Hong Kong	0.000	0.59***	-0.06	1.04	0.04	0.96	0.870	96
India	0.000	1.04***	-0.18	1.15	0.48	0.62	0.891	96
Ireland	0.009	0.06	-0.03	1.25	1.44	0.24	0.667	96
Italy	-0.001	0.39**	-0.09	1.06	0.17	0.85	0.833	96
Japan	0.001	0.97***	0.11	0.96	0.09	0.91	0.843	96
Netherlands	0.002	0.04	0.16**	1.08	0.51	0.60	0.871	96
Norway	0.008	0.78***	-0.07	1.25	3.40	0.04**	0.833	96
Russia	0.015**	0.89***	-0.32*	1.65	7.27	0.00***	0.813	96
Singapore	0.007*	1.14***	-0.17**	0.95	1.99	0.15	0.903	96
Spain	0.005	0.53***	-0.02	1.06	1.31	0.28	0.833	96
Sweden	0.004	0.59***	-0.03	1.06	0.96	0.39	0.847	96
Switzerland	0.004	0.22	0.08	1.14	2.35	0.10	0.852	96
UK	0.005	0.59***	0.18**	1.15	3.00	0.06*	0.854	96
US	0.005*	1.16***	0.07	1.21	6.02	0.00***	0.911	96
Korea	-0.002	0.91***	0.91***	0.86	0.53	0.59	0.786	96

3.2.2 No-hedge scenario

Table 7 reports the results of the mean-variance spanning test assuming that the exchange rate risk is not hedged. In general, the results are similar to those under the full-hedge scenario shown in Table 6 during the whole sample period. The difference is that

small-cap funds from a slightly smaller number of countries reject the null hypothesis of the spanning test, compared to under the full-hedge scenario. At the 5% significance level, three countries reject the null hypothesis under the full-hedge scenario, but only two countries do so under the no-hedge scenario. More concretely, Belgium, Canada, and Finland reject the null hypothesis under the full-hedge scenario at the 5% significance level. Under the no-hedge scenario, the null hypothesis is rejected in Canada and Japan at the 5% significance level. As shown above, the results under the no-hedge scenario show that small-cap funds from most countries fail to reject the null hypothesis of the spanning test. Hence, it is hard for investors seeking international portfolio diversification to gain additional international diversification benefits by investing in small-cap funds from foreign countries, compared to index funds from foreign countries. And this phenomenon becomes more evident during the second sub-period than the first sub-period. During the first sub-period, five countries (Canada, Denmark, France, Germany, and Ireland) reject the null hypothesis of the spanning test for small-cap fund returns at the 5% significance level. On the other hand, the null hypothesis is rejected in only three countries (Brazil, Japan, and Russia) during the second sub-period. In the end, the results indicate that the additional benefits that investors expect to gain from international portfolio diversification through small-cap funds have rapidly decreased since the 2000s.

Table 7. Spanning Test Results (no-hedge)

This table reports the spanning test results under the no-hedge scenario through the following regression equation:

$$R_i = \alpha_i + \sum_{j=1}^{K} \beta_{ij} MSCI_j + \epsilon_i,$$

where R_i denotes the small-cap fund return in country i, $MSCI_j$ denotes the MSCI country index return in country j, and $\epsilon_i \sim iid(0, \sigma^2)$. F-Stat reports the test statistic for the null hypothesis (H_0 : $\alpha = 0$ and $\sum_{j=1}^{K} \beta_{ij} = 1$), and β_{iKorea} is a beta of small-cap funds from each sample country against Korea's MSCI index return. ***, **, and * denote the 1%, 5%, and 10% significance levels, respectively.

Panel A: Overall sample period (June 1994-December 2010)

Country	α_i	β_i	β_{iKorea}	$\sum_{j=1}^{K} \beta_{ij}$	F-Stat	P-Value	R^2	Obs
Australia	0.006	0.57***	0.09*	1.17	2.19	0.12	0.463	192
Belgium	0.001	0.36***	-0.01	0.74	2.09	0.13	0.374	192
Brazil	0.005	0.40***	0.03	1.11	0.49	0.62	0.491	192
Canada	0.010***	0.63***	0.00	0.64	8.08	0.00***	0.383	192
China	0.006	0.78***	-0.06	0.95	1.25	0.29	0.843	192
Denmark	0.005	0.49***	0.03	0.92	0.86	0.43	0.393	192
Finland	0.008*	-0.07	0.04	0.72	2.83	0.06*	0.302	192
France	0.007*	0.17	0.07	0.85	1.90	0.15	0.376	192
Germany	-0.002	0.45***	0.04	0.85	0.84	0.44	0.446	192
Hong Kong	0.002	0.45***	-0.09**	0.87	0.56	0.57	0.710	192
India	0.002	1.00***	0.07	0.94	0.20	0.82	0.704	192
Ireland	0.012**	0.49***	0.06	1.01	2.11	0.12	0.333	192
Italy	0.006	0.81***	0.05	0.91	1.08	0.34	0.517	192
Japan	0.004	0.80***	0.33***	0.59	4.54	0.01**	0.488	192
Netherlands	0.002	0.32*	0.07	0.85	0.78	0.46	0.452	192
Norway	0.002	0.64***	0.05	1.04	0.24	0.79	0.556	192
Russia	0.012	0.77***	-0.01	0.92	0.92	0.40	0.654	175
Singapore	0.005	0.91***	0.00	0.89	1.72	0.18	0.799	192
Spain	0.006	0.47***	0.04	0.85	1.43	0.24	0.441	192
Sweden	0.006	0.55***	0.04	1.00	1.07	0.35	0.510	192
Switzerland	0.007*	0.25*	0.07	0.79	2.53	0.08*	0.394	192
UK	0.005	0.44**	0.03	0.82	1.67	0.19	0.390	192
US	0.007*	0.02	0.01	0.84	2.02	0.14	0.427	192
Korea	-0.005	0.89***	0.89***	0.88	1.03	0.36	0.747	192

Panel B: First sub-period (June 1994-December 2002)

Country	α_i	β_i	β_{iKorea}	$\sum_{j=1}^{K}\beta_{ij}$	F-Stat	P-Value	R^2	Obs
Australia	0.009	0.54*	0.13*	0.91	0.97	0.39	0.442	96
Belgium	-0.001	-0.01	0.02	0.57	1.35	0.27	0.340	96
Brazil	-0.007	0.37**	0.07	0.84	0.24	0.79	0.426	96
Canada	0.012*	0.51**	0.01	0.56	3.66	0.03**	0.328	96
China	0.006	0.79***	-0.02	0.69	1.46	0.24	0.866	96
Denmark	0.006	0.09	0.08	0.33	4.11	0.02**	0.327	96
Finland	0.012	-0.08	0.09	0.40	2.97	0.06*	0.253	96
France	0.009	0.05	0.10	0.48	3.31	0.04**	0.346	96
Germany	-0.010	0.86***	0.09	0.35	3.59	0.03**	0.445	96
Hong Kong	0.003	0.42***	-0.09	0.88	0.22	0.80	0.735	96
India	0.000	0.95***	0.13*	0.67	0.77	0.47	0.682	96
Ireland	0.018**	0.84***	0.12*	0.53	4.52	0.01**	0.497	96
Italy	0.010	0.97***	0.09	0.66	1.69	0.19	0.529	96
Japan	0.002	0.82***	0.35***	0.74	0.42	0.66	0.569	96
Netherlands	0.003	0.71**	0.09	0.61	1.32	0.28	0.437	96
Norway	-0.002	0.56***	0.11*	0.71	0.69	0.51	0.513	96
Russia	0.018	0.76***	0.20	-0.07	2.25	0.12	0.752	79
Singapore	0.003	0.79***	0.04	0.81	0.52	0.60	0.836	96
Spain	0.006	0.39**	0.09	0.55	2.00	0.14	0.455	96
Sweden	0.008	0.37**	0.06	0.62	1.94	0.15	0.514	96
Switzerland	0.007	0.62***	0.09	0.58	2.16	0.12	0.483	96
UK	0.009	1.01***	0.02	0.92	1.10	0.34	0.404	96
US	0.012	-0.31	0.00	0.86	1.52	0.23	0.446	96
Korea	-0.012	0.90***	0.90***	0.64	1.52	0.23	0.762	96

Panel C: Second sub-period (January 2003-December 2010)

Country	α_i	β_i	β_{iKorea}	$\sum_{j=1}^{K}\beta_{ij}$	F-Stat	P-Value	R^2	Obs
Australia	0.001	0.66***	0.06	1.27	1.94	0.15	0.754	96
Belgium	0.005	0.37***	-0.12	0.90	0.68	0.51	0.724	96
Brazil	0.006	0.90***	-0.17	1.60	4.34	0.02**	0.740	96
Canada	0.001	1.08***	0.02	0.86	0.65	0.53	0.707	96
China	0.003	0.68***	0.07	1.03	0.22	0.80	0.873	96
Denmark	0.004	0.63***	-0.01	1.21	1.60	0.21	0.798	96
Finland	0.006	-0.15	-0.07	0.95	0.69	0.51	0.721	96
France	0.005	0.75*	0.07	1.15	1.48	0.23	0.744	96
Germany	0.004	0.21	-0.07	1.16	1.36	0.26	0.776	96
Hong Kong	-0.002	0.50***	-0.05	0.87	0.69	0.50	0.815	96
India	-0.002	1.03***	-0.21	1.06	0.10	0.91	0.830	96
Ireland	0.008	-0.12	-0.08	1.21	0.99	0.38	0.599	96
Italy	-0.001	0.59***	-0.14	1.02	0.06	0.94	0.712	96
Japan	0.004	0.67***	0.21	0.54	3.22	0.05**	0.436	96
Netherlands	0.001	-0.06	0.11	1.04	0.06	0.94	0.741	96
Norway	0.007	0.61***	-0.05	1.35	2.28	0.11	0.709	96
Russia	0.013	0.90***	-0.40*	1.70	4.97	0.01***	0.732	96
Singapore	0.007*	1.11***	-0.15*	0.82	2.54	0.09*	0.851	96
Spain	0.005	0.62***	-0.07	1.01	0.40	0.67	0.670	96
Sweden	0.003	0.72***	0.00	1.31	2.39	0.10*	0.752	96
Switzerland	0.007	-0.21	0.07	0.87	0.95	0.39	0.585	96
UK	0.002	-0.08	0.07	0.96	0.13	0.88	0.666	96
US	0.003	0.55**	0.08	1.01	0.31	0.73	0.640	96
Korea	-0.002	0.91***	0.91***	0.86	0.53	0.59	0.786	96

3.2.3 Analysis on the sensitivity to the global financial crisis

It is possible that extreme market conditions such as the global financial crisis may alter the above results. In order to check that our results are not primarily driven by the 1997 Asian financial crisis and the 2008 global financial crisis, we exclude two crisis-ridden periods and then use the same methodology to perform mean-variance

spanning tests for small-cap funds from 24 sample countries including Korea. We run two scenarios; one assumes that the exchange rate risk is fully hedged, and the other that exchange rate risk is not hedged. Appendix 1 and Appendix 2 report the results: No significant difference is found between the results including and excluding the crisis-ridden periods for both scenarios. This suggests that the results of our analysis are not primarily driven by extreme market conditions such as a financial crisis.

3.3 Return structures and variance decomposition

In this section, we attempt to confirm our findings that the integration of global capital markets diminishes the benefits from international portfolio diversification. We decompose small-cap fund returns from each country into local and global elements, and estimate the impact of each element. To do so, we perform a two-variable regression analysis. The two variables here are the MSCI World index that reflects global aspects, and the market return in each country that reflects local aspects. We assess the impact of global and local aspects in small-cap fund returns from each country by using the following model:

$$R_i = \alpha_i + \beta_i^W R^W + \beta_i^C R_i^C + \epsilon_i \qquad (3)$$

where R_i is the small-cap fund return for country i, and R^W is the return on the MSCI World index. R_i^C is the market return of country i that is unrelated to the MSCI World index. This is the residual from regressing the market return of country i on the MSCI World index.

Hence, the coefficients β_i^W and β_i^C of R^W and R_i^C, respectively, are interdependently orthogonal.

Once the estimates are made using Equation (3), we decompose the variance of returns on small-cap funds from each country (Var(R)) into three elements contributing to volatility; volatility of returns on the MSCI World index (Global), the national market index (Country), and funds (Fund).

Given that our analysis aims to show that the integration of global capital markets is diminishing the benefits from international portfolio diversification, we divide our sample period into two sub-periods as above.

Table 8 reports the results of the 2-variable regression analysis and variance decomposition under the full-hedge scenario. Above all, global as well as local factors have a statistically significant impact in almost all nations. Especially notable is that the average of local factor coefficients in sample countries shows no significant difference over the two sub-periods, whereas that of global factor coefficients increases sharply from 0.83 in the first sub-period to 1.30 in the second sub-period. Furthermore, the results of variance decomposition demonstrate that the impact of global factors remains the lowest at 30% in the first sub-period, but grows wildly to 61% in the second sub-period. On the other hand, the impact of funds themselves is found to have fallen sharply from 40% to 25%.[8)]

8) The results under the no-hedge scenario are similar to those under the full-hedge scenario.

Table 8. Return Structures of Small-cap Funds and Variance Decomposition (full-hedge)

This table reports the return structures of small-cap funds from sample countries using the below regression analysis and variance decomposition:

$$R_{ij} = \alpha_i + \beta_i^W R^W + \beta_i^C R_i^C + \epsilon_i,$$

where R_i denotes the return on small-cap funds from country i, and R^W denotes the return on the MSCI World index. R_i^C is the market return of country i that is unrelated to the MSCI World index, and this is the residual from regressing the market return of country i on the MSCI World index. In the 2-variable regression analysis table, $\sigma(\epsilon)$ and Adj-R^2 are standard deviation of the residual, and the adjusted coefficient of determination. The variance decomposition table decomposes the variance of the return from each fund (Var(R)) into three elements contributing to return volatility, which include return volatility of the MSCI World index (Global), the national market index (Country), and funds (Fund).

Panel A: Sample period (June 1994-December 2010)

Country	2-variable regression analysis						Variance decomposition (%)			
	β^W	(t-stat)	β^C	(t-stat)	$\sigma(\varepsilon)$	$Adj.R^2$	var(R)	Global	Country	Fund
Australia	0.76	(17.21)	0.89	(11.18)	0.027	0.678	0.002	0.48	0.21	0.32
Belgium	0.82	(16.23)	0.50	(8.72)	0.030	0.629	0.003	0.49	0.14	0.37
Brazil	1.03	(11.42)	0.66	(12.57)	0.055	0.590	0.007	0.28	0.34	0.39
Canada	0.85	(15.86)	0.68	(8.17)	0.032	0.614	0.003	0.50	0.13	0.38
China	1.15	(14.77)	0.89	(25.18)	0.047	0.810	0.012	0.21	0.61	0.19
Denmark	0.91	(14.88)	0.65	(9.49)	0.037	0.609	0.003	0.44	0.18	0.39
Finland	0.89	(11.56)	0.04	(0.94)	0.047	0.400	0.004	0.41	0.00	0.60
France	0.93	(16.96)	0.51	(5.79)	0.033	0.616	0.003	0.56	0.07	0.38
Germany	1.09	(16.45)	0.64	(7.17)	0.040	0.617	0.004	0.52	0.10	0.38
Hong Kong	1.26	(14.27)	0.92	(14.39)	0.053	0.673	0.009	0.33	0.34	0.33
India	0.97	(12.7)	1.01	(21.73)	0.046	0.760	0.009	0.20	0.58	0.23
Ireland	1.18	(12.2)	0.50	(5.28)	0.059	0.468	0.006	0.40	0.08	0.53
Italy	1.04	(17.86)	0.85	(13.95)	0.035	0.720	0.004	0.45	0.28	0.28
Japan	0.63	(9.9)	1.20	(16.43)	0.038	0.648	0.004	0.17	0.48	0.34
Korea	1.11	(11.64)	0.87	(17.66)	0.058	0.691	0.011	0.21	0.49	0.31
Netherlands	1.06	(18.9)	0.67	(7.89)	0.034	0.677	0.004	0.58	0.10	0.32
Norway	1.24	(19.84)	0.81	(13.09)	0.038	0.739	0.005	0.52	0.23	0.26
Russia	1.81	(10.3)	0.78	(13.02)	0.104	0.612	0.027	0.22	0.45	0.37
Singapore	1.29	(19.81)	1.16	(21.23)	0.039	0.809	0.008	0.38	0.44	0.19
Spain	0.93	(16.01)	0.64	(9.68)	0.035	0.636	0.003	0.47	0.17	0.36
Sweden	1.06	(17.52)	0.53	(8.92)	0.037	0.659	0.004	0.54	0.14	0.34
Switzerland	1.03	(17.97)	0.44	(5.1)	0.035	0.636	0.003	0.60	0.05	0.36
UK	0.95	(16.44)	0.61	(4.73)	0.035	0.594	0.003	0.55	0.05	0.41
US	1.14	(18.24)	0.07	(0.35)	0.038	0.624	0.004	0.64	0.00	0.37
Average	1.05		0.69		0.043	0.646	0.006	0.42	0.24	0.35

Panel B: First sub-period (June 1994-December 2002)

Country	2-variable regression analysis						Variance decomposition (%)			
	β^W	(t-stat)	β^C	(t-stat)	$\sigma(\varepsilon)$	$Adj.R^2$	var(R)	Global	Country	Fund
Australia	0.40	(7.07)	0.85	(9.16)	0.025	0.561	0.001	0.21	0.36	0.43
Belgium	0.62	(8.78)	0.45	(5.18)	0.031	0.498	0.002	0.37	0.13	0.48
Brazil	0.75	(5.9)	0.67	(11.05)	0.056	0.601	0.008	0.14	0.49	0.38
Canada	0.66	(8.77)	0.56	(5.22)	0.033	0.498	0.002	0.38	0.14	0.49
China	0.87	(7.21)	0.89	(19.21)	0.053	0.803	0.014	0.10	0.71	0.19
Denmark	0.44	(6.98)	0.50	(7.19)	0.028	0.489	0.002	0.24	0.26	0.50
Finland	0.67	(6.49)	0.03	(0.53)	0.045	0.282	0.003	0.30	0.00	0.71
France	0.63	(9.71)	0.50	(5.76)	0.029	0.549	0.002	0.42	0.15	0.44
Germany	0.85	(8.59)	0.72	(6.06)	0.044	0.513	0.004	0.35	0.18	0.44
Hong Kong	1.12	(7.89)	0.89	(10.08)	0.063	0.611	0.010	0.23	0.38	0.38
India	0.31	(2.95)	0.89	(15.09)	0.047	0.695	0.007	0.03	0.68	0.30
Ireland	0.84	(8.31)	0.74	(6.39)	0.045	0.511	0.004	0.34	0.20	0.47
Italy	0.97	(10.69)	0.91	(11.6)	0.040	0.706	0.005	0.33	0.39	0.29
Japan	0.45	(4.2)	1.31	(10.83)	0.048	0.564	0.005	0.08	0.50	0.41
Korea	1.06	(6.72)	0.85	(13.39)	0.069	0.683	0.015	0.14	0.55	0.31
Netherlands	0.87	(11.5)	0.80	(7.08)	0.034	0.637	0.003	0.46	0.18	0.36
Norway	1.03	(12.59)	0.77	(9.22)	0.036	0.701	0.004	0.46	0.25	0.28
Russia	1.67	(5.27)	0.79	(9.1)	0.135	0.584	0.043	0.12	0.50	0.39
Singapore	1.24	(11.54)	1.15	(15.27)	0.047	0.780	0.010	0.28	0.50	0.21
Spain	0.82	(11.05)	0.70	(9.09)	0.033	0.663	0.003	0.40	0.27	0.33
Sweden	0.89	(10.48)	0.55	(7.36)	0.037	0.611	0.004	0.42	0.21	0.38
Switzerland	0.89	(10.59)	0.51	(4.64)	0.037	0.561	0.003	0.48	0.09	0.43
UK	0.79	(9.2)	0.60	(3.4)	0.038	0.478	0.003	0.43	0.06	0.51
US	0.98	(9.4)	-0.24	(-0.81)	0.046	0.458	0.004	0.47	0.00	0.54
Average	0.83		0.68		0.046	0.585	0.007	0.30	0.30	0.40

Panel C: Second sub-period (January 2003-December 2010)

Country	2-variable regression analysis						Variance decomposition (%)			
	β^W	(t-stat)	β^C	(t-stat)	$\sigma(\varepsilon)$	$Adj.R^2$	var(R)	Global	Country	Fund
Australia	1.17	(21.8)	0.62	(5.24)	0.022	0.839	0.003	0.80	0.05	0.16
Belgium	1.04	(15.1)	0.52	(6.66)	0.028	0.738	0.003	0.63	0.12	0.26
Brazil	1.36	(11.62)	0.67	(6.83)	0.048	0.652	0.006	0.54	0.19	0.31
Canada	1.07	(16.6)	1.01	(8.76)	0.027	0.785	0.003	0.63	0.18	0.21
China	1.47	(14.55)	0.92	(13.43)	0.042	0.803	0.008	0.46	0.39	0.17
Denmark	1.43	(18.28)	0.81	(8.79)	0.032	0.810	0.005	0.67	0.16	0.19
Finland	1.15	(10.53)	0.20	(2.23)	0.045	0.543	0.004	0.54	0.02	0.45
France	1.27	(17.22)	0.76	(4.44)	0.030	0.766	0.004	0.74	0.05	0.23
Germany	1.36	(17.9)	0.53	(4.23)	0.031	0.778	0.004	0.76	0.04	0.21
Hong Kong	1.42	(14.22)	1.02	(10.51)	0.041	0.764	0.007	0.51	0.28	0.23
India	1.73	(15.92)	1.09	(13.2)	0.045	0.816	0.010	0.51	0.36	0.16
Ireland	1.57	(9.71)	0.30	(2.11)	0.067	0.502	0.009	0.49	0.02	0.49
Italy	1.12	(16.16)	0.64	(5.93)	0.029	0.754	0.003	0.66	0.09	0.24
Japan	0.83	(13.44)	1.03	(13.62)	0.025	0.791	0.003	0.39	0.41	0.21
Korea	1.17	(11.28)	0.95	(9.5)	0.043	0.692	0.006	0.42	0.30	0.29
Netherlands	1.28	(16.95)	0.58	(4.92)	0.031	0.763	0.004	0.72	0.06	0.23
Norway	1.48	(14.83)	0.80	(7.86)	0.041	0.745	0.006	0.61	0.17	0.24
Russia	1.92	(12.13)	0.85	(9.46)	0.066	0.710	0.014	0.46	0.28	0.28
Singapore	1.34	(17.96)	1.18	(12.92)	0.031	0.835	0.006	0.57	0.30	0.15
Spain	1.06	(12.09)	0.58	(5.15)	0.036	0.640	0.004	0.55	0.10	0.36
Sweden	1.26	(16.51)	0.65	(6.98)	0.032	0.769	0.004	0.68	0.12	0.22
Switzerland	1.19	(16.39)	0.39	(2.72)	0.030	0.741	0.003	0.75	0.02	0.25
UK	1.14	(15.29)	0.52	(2.79)	0.031	0.714	0.003	0.71	0.02	0.28
US	1.31	(25.02)	0.97	(4.36)	0.022	0.870	0.004	0.86	0.03	0.13
Average	1.30		0.73		0.036	0.742	0.005	0.61	0.16	0.25

4. Conclusion

In this paper, we evaluated the potential that international funds, especially small-cap funds, may hold to provide Korean investors with the benefits of international portfolio diversification. For this, we obtained MSCI monthly indices from 24 sample countries provided by Datastream during the sample period between June 1994 and December 2010 and the sub-periods; the first sub-period (before 2003) and the second sub-period (after 2003). We analyzed the returns, risks, and Sharpe measures on large-cap and small-cap funds, the correlations among funds, and the mean-variance spanning tests for small-cap funds, in relation to foreign exchange rates.

Our key findings are as follows. First we found that the returns on funds (including MSCI country index, small-cap and large-cap funds) from sample countries have a negative correlation with the Korean won's foreign exchange rates against sample country currencies. Given the positive correlation between Korean fund returns and international fund returns, this confirms the complementary relationship between domestic fund investments and exchange rate volatility arising from international fund investments.

Second, although numerous studies have shown the benefits of portfolio diversification across countries, industries, and stocks by market capitalization, the progress of global synchronization is mitigating those benefits.

Third, we found that Korea's synchronization is higher with developed countries or Asian countries than with BRICs, and that the Sharpe measures for MSCI index funds are higher in BRICs than other countries. This shows that the investments in BRICs are more attractive than those in other countries. On the other hand, we found that in Asian countries, the Sharpe measures for the returns on MSCI

index funds are significantly low and highly correlated to Korea. This suggests that investing in funds from Asian countries offer limited international diversification benefits. Given that, Korea's international funds that are heavily weighted towards the Asian Continent might have borne the brunt of the global financial crisis.

Third, we found via spanning tests that most countries fail to reject the null hypothesis of the spanning test on small-cap funds. This means that investing in foreign small-cap funds, rather than foreign market index funds, cannot augment Korean investors' benefits from international portfolio diversification. Such a phenomenon becomes more evident in the second sub-period. Combining this with the correlation results leads to the implication that the integration of global capital markets is diminishing the additional benefits from international portfolio diversification. Also found is that small-cap funds in most countries form a statistically significant beta against their national market index only.

Fourth, we found in a serious of analyses on the two scenarios for hedging the exchange rate risk that the Sharpe ratios become higher and the correlations among fund returns across countries become lower under the no-hedge scenario than the full-hedge scenario. Under the no-hedge scenario, most countries pass the spanning test on small-cap fund returns in the first sub-period. In the second sub-period, however, the number of countries that fail to pass the spanning test on small-cap fund returns falls under both full-hedge and no-hedge scenarios.

Last, our analysis on return structures of small-cap funds and variance decomposition confirms that the impact of global factors on returns and variance have increased more dramatically in the second sub-period than in the first sub-period.

In conclusion, we found that the global stock market

synchronization that began in the 1990s and further accelerated in the 2000s has been diminishing the additional benefits from international portfolio diversification via international funds. Hence, Korean investors should ponder upon their strategies for international portfolio diversification, especially when using small-cap international funds as a vehicle. It is recommended that those investors develop a new strategy to enhance the efficiency of international portfolio diversification.

Appendix I

Table 9. Robust Spanning Test Results (full-hedge)

This table reports the spanning test results during the sample period excluding the 1997 Asian financial crisis and the 2008 global financial crisis under the full-hedge scenario. The regression equation is as follows:

$$R_i = \alpha_i + \sum_{j=1}^{K} \beta_{ij} MSCI_j + \epsilon_i,$$

where R_i denotes the fund return of country i, and $MSCI_j$ denotes the MSCI index return of country j, and $\epsilon_i \sim iid(0, \sigma^2)$. F-Stat reports the test statistic for the null hypothesis ($H_0 : \alpha = 0$ and $\sum_{j=1}^{K} \beta_{ij} = 1$), and β_{iKorea} is a beta of small-cap funds from each sample country against Korea's MSCI index return. ***, **, and * denote the 1%, 5%, and 10% significance levels, respectively.

Panel A: Overall sample period (June 1994-December 2010)

Country	α_i	β_i	β_{iKorea}	$\sum_{j=1}^{K} \beta_{ij}$	F-Stat	P-Value	R^2	Obs
Australia	0.005***	0.68***	-0.01	0.99	3.80	0.03**	0.672	168
Belgium	-0.001	0.44***	-0.05*	0.82	2.32	0.10	0.663	168
Brazil	0.006	0.43***	-0.03	0.89	1.35	0.26	0.658	168
Canada	0.006***	0.50***	0.02	0.83	4.66	0.01**	0.672	168
China	0.006	0.78***	-0.05	0.94	1.27	0.29	0.838	168
Denmark	0.006**	0.50***	-0.03	0.93	2.34	0.10*	0.608	168
Finland	0.007*	0.02	0.00	0.87	2.05	0.13	0.557	168
France	0.005**	0.29**	0.02	0.93	2.28	0.11	0.695	168
Germany	-0.005*	0.64***	0.01	0.89	2.29	0.11	0.716	168
Hong Kong	0.000	0.47***	-0.15***	1.10	0.36	0.70	0.804	168
India	0.005	1.01***	0.03	0.99	0.95	0.39	0.795	168
Ireland	0.008	0.60***	-0.01	1.25	2.76	0.07*	0.509	168
Italy	0.004	0.88***	0.00	1.00	0.85	0.43	0.765	168
Japan	0.004	1.10***	0.13***	1.02	1.14	0.32	0.774	168
Netherlands	0.000	0.33***	0.00	1.05	0.16	0.85	0.758	168
Norway	0.000	0.82***	0.02	1.08	0.26	0.77	0.754	168
Russia	0.017*	0.76***	0.07	0.96	1.94	0.15	0.713	151
Singapore	0.004	0.98***	-0.04	1.08	1.54	0.22	0.854	168
Spain	0.004	0.47***	-0.01	0.90	1.61	0.20	0.715	168
Sweden	0.007**	0.45***	-0.01	0.91	2.93	0.06*	0.731	168
Switzerland	0.002	0.37***	-0.03	1.09	1.31	0.27	0.793	168
UK	0.001	0.53***	0.02	1.22	3.38	0.04**	0.740	168
US	0.002	0.31**	-0.04	1.13	1.36	0.26	0.726	168
Korea	-0.003	0.87***	0.87***	0.98	0.22	0.80	0.773	168

Panel B: First sub-period (June 1994-December 2002)

Country	α_i	β_i	β_{iKorea}	$\sum_{j=1}^{K}\beta_{ij}$	F-Stat	P-Value	R^2	Obs
Australia	0.006*	0.52***	0.01	0.77	3.68	0.03**	0.623	84
Belgium	-0.007*	0.30**	-0.03	0.64	4.73	0.01**	0.685	84
Brazil	0.000	0.40***	-0.02	0.61	1.35	0.27	0.707	84
Canada	0.007*	0.48***	0.04	0.64	4.27	0.02**	0.678	84
China	0.004	0.81***	0.00	0.72	0.71	0.50	0.876	84
Denmark	0.004	0.29***	0.01	0.42	8.53	0.00***	0.621	84
Finland	0.006	0.01	0.05	0.50	3.63	0.03**	0.551	84
France	0.006	0.23	0.05	0.58	6.17	0.00***	0.718	84
Germany	-0.015***	0.77***	0.04	0.44	9.14	0.00***	0.755	84
Hong Kong	-0.003	0.48***	-0.12**	1.06	0.21	0.81	0.850	84
India	0.002	0.96***	0.08	0.81	0.39	0.68	0.799	84
Ireland	0.015***	0.85***	0.07	0.61	8.26	0.00***	0.788	84
Italy	0.007	1.02***	0.02	0.76	1.62	0.21	0.793	84
Japan	0.005	1.05***	0.15***	1.03	0.50	0.61	0.799	84
Netherlands	0.000	0.75***	0.02	0.81	0.72	0.49	0.792	84
Norway	-0.006	0.73***	0.06	0.75	1.74	0.18	0.790	84
Russia	0.020	0.81***	0.25	0.21	1.41	0.26	0.805	67
Singapore	0.001	0.87***	0.00	0.96	0.04	0.97	0.888	84
Spain	0.003	0.44***	0.03	0.60	3.53	0.04**	0.761	84
Sweden	0.006	0.38***	0.01	0.59	3.44	0.04**	0.761	84
Switzerland	0.000	0.44***	0.01	0.81	1.08	0.35	0.863	84
UK	0.002	0.65***	0.01	1.31	2.68	0.08*	0.823	84
US	0.006	-0.17	-0.03	0.96	0.80	0.45	0.740	84
Korea	-0.010	0.86***	0.86***	0.92	0.76	0.47	0.825	84

Panel C: Second sub-period (January 2003-December 2010)

Country	α_i	β_i	β_{iKorea}	$\sum_{j=1}^{K}\beta_{ij}$	F-Stat	P-Value	R^2	Obs
Australia	0.004	0.81***	0.03	1.12	3.03	0.06*	0.848	84
Belgium	0.007*	0.49***	-0.06	0.91	1.76	0.18	0.790	84
Brazil	0.009	0.82***	0.05	1.04	1.60	0.21	0.720	84
Canada	0.001	0.83***	0.02	1.14	1.10	0.34	0.788	84
China	0.004	0.65***	0.14	1.13	0.88	0.42	0.857	84
Denmark	0.007	0.42***	0.00	1.36	7.12	0.00***	0.835	84
Finland	0.009*	0.01	-0.04	1.15	3.24	0.05**	0.787	84
France	0.005	0.30	0.12	1.20	3.29	0.04**	0.837	84
Germany	0.001	0.45***	-0.03	1.28	3.08	0.05*	0.842	84
Hong Kong	0.005	0.55***	-0.10	1.13	1.29	0.28	0.832	84
India	0.001	0.97***	-0.13	1.17	0.50	0.61	0.849	84
Ireland	-0.003	0.04	-0.09	1.81	3.63	0.03**	0.675	84
Italy	-0.003	0.43**	-0.11	1.18	0.88	0.42	0.784	84
Japan	-0.001	1.04***	0.11	1.07	0.13	0.88	0.829	84
Netherlands	-0.002	0.02	0.11	1.31	3.13	0.05*	0.848	84
Norway	0.006	0.94***	-0.06	1.33	3.12	0.05*	0.786	84
Russia	0.016*	0.83***	-0.34*	1.77	8.65	0.00***	0.758	84
Singapore	0.009**	1.10***	-0.24***	1.12	4.74	0.01**	0.882	84
Spain	0.005	0.50***	0.02	1.07	1.13	0.33	0.789	84
Sweden	0.008**	0.61***	0.01	1.06	3.04	0.06*	0.827	84
Switzerland	0.004	0.32*	-0.03	1.23	3.09	0.05*	0.819	84
UK	0.003	0.52**	0.21***	1.22	2.92	0.06*	0.813	84
US	0.002	1.04***	0.04	1.31	6.80	0.00***	0.899	84
Korea	0.002	0.95***	0.95***	0.67	1.50	0.23	0.750	84

Panel C: Second sub-period (January 2003-December 2010)

Country	α_i	β_i	β_{iKorea}	$\sum_{j=1}^{K}\beta_{ij}$	F-Stat	P-Value	R^2	Obs
Australia	0.006	0.64***	0.09	1.03	0.96	0.39	0.644	84
Belgium	0.007	0.53***	-0.09	0.70	2.12	0.13	0.684	84
Brazil	0.005	1.00***	0.07	1.19	0.71	0.49	0.699	84
Canada	0.003	0.77***	0.07	0.67	2.63	0.08*	0.592	84
China	0.002	0.65***	0.12	1.14	0.58	0.56	0.848	84
Denmark	0.006	0.53***	-0.03	1.17	1.65	0.20	0.705	84
Finland	0.009	-0.11	-0.07	0.95	1.24	0.30	0.718	84
France	0.004	0.41	0.09	1.00	0.49	0.62	0.712	84
Germany	0.001	0.33	-0.06	1.08	0.21	0.81	0.762	84
Hong Kong	0.004	0.46***	-0.07	0.67	2.02	0.14	0.753	84
India	0.000	0.99***	-0.12	0.84	0.31	0.73	0.810	84
Ireland	-0.003	-0.19	-0.13	1.62	1.73	0.19	0.608	84
Italy	-0.003	0.65***	-0.14	0.99	0.19	0.82	0.665	84
Japan	0.000	0.88***	0.18	0.54	3.55	0.04**	0.582	84
Netherlands	-0.002	-0.20	0.07	1.11	0.23	0.80	0.709	84
Norway	0.007	0.92***	0.02	1.18	1.35	0.27	0.689	84
Russia	0.017*	0.78***	-0.41*	1.55	4.65	0.01**	0.690	84
Singapore	0.009**	1.05***	-0.23**	0.82	2.52	0.09*	0.804	84
Spain	0.005	0.56***	-0.01	0.87	0.44	0.65	0.667	84
Sweden	0.007	0.65***	0.06	1.18	2.10	0.13	0.736	84
Switzerland	0.006	-0.10	-0.04	0.89	0.60	0.55	0.574	84
UK	0.003	0.18	0.13	0.82	0.56	0.58	0.641	84
US	0.002	0.46*	0.07	0.86	0.39	0.68	0.644	84
Korea	0.002	0.95***	0.95***	0.67	1.50	0.23	0.750	84

Table 10. Robust Spanning Test Results (no-hedge)

This table reports the spanning test results during the sample period excluding the 1997 Asian financial crisis and the 2008 global financial crisis under the no-hedge scenario. The regression equation is as follows:

$$R_i = \alpha_i + \sum_{j=1}^{K} \beta_{ij} MSCI_j + \epsilon_i.$$

where R_i denotes the fund return of country i, and $MSCI_j$ denotes the MSCI index return of country j, and $\epsilon_i \sim iid(0,\sigma^2)$. F-Stat reports the test statistic for the null hypothesis (H_0 : $\alpha = 0$ and $\sum_{j=1}^{K} \beta_{ij} = 1$), and β_{iKorea} is a beta of small-cap funds from each sample country against Korea's MSCI index return. ***, **, and * denote the 1%, 5%, and 10% significance levels, respectively.

Panel A: Overall sample period (June 1994-December 2010)

Country	α_i	β_i	β_{iKorea}	$\sum_{j=1}^{K} \beta_{ij}$	F-Stat	P-Value	R^2	Obs
Australia	0.009**	0.36**	0.11**	0.97	2.40	0.09*	0.429	168
Belgium	0.001	0.43***	0.01	0.62	3.96	0.02**	0.373	168
Brazil	0.003	0.40***	0.05	1.09	0.18	0.84	0.451	168
Canada	0.009***	0.57***	0.04	0.44	12.94	0.00***	0.412	168
China	0.005	0.78***	-0.05	0.94	0.91	0.41	0.835	168
Denmark	0.008*	0.32***	0.04	0.74	2.73	0.07*	0.321	168
Finland	0.008*	-0.01	0.06	0.67	2.77	0.07*	0.329	168
France	0.007*	0.04	0.08*	0.72	3.04	0.05*	0.387	168
Germany	-0.004	0.63***	0.06	0.70	2.94	0.06*	0.495	168
Hong Kong	0.001	0.47***	-0.11***	0.72	2.29	0.11	0.749	168
India	0.005	1.01***	0.10**	0.67	2.38	0.10*	0.728	168
Ireland	0.010	0.51***	0.06	1.05	1.43	0.24	0.326	168
Italy	0.005	0.78***	0.08	0.79	1.47	0.23	0.522	168
Japan	0.004	0.94***	0.32***	0.73	1.63	0.20	0.580	168
Netherlands	0.001	0.43**	0.06	0.86	0.52	0.60	0.483	168
Norway	0.002	0.80***	0.08	0.94	0.16	0.85	0.582	168
Russia	0.010	0.74***	0.07	0.82	0.69	0.50	0.678	151
Singapore	0.007*	0.92***	-0.01	0.83	2.09	0.13	0.793	168
Spain	0.006	0.48***	0.06	0.69	2.86	0.06*	0.430	168
Sweden	0.008*	0.48***	0.04	0.92	1.74	0.18	0.529	168
Switzerland	0.006	0.25*	0.06	0.78	1.93	0.15	0.447	168
UK	0.004	0.62***	0.06	0.79	1.44	0.24	0.464	168
US	0.004	-0.15	0.03	0.74	2.00	0.14	0.483	168
Korea	-0.003	0.87***	0.87***	0.98	0.22	0.80	0.773	168

Panel B: First sample-period (June 1994-December 2002)

Country	α_i	β_i	β_{iKorea}	$\sum_{j=1}^{K}\beta_{ij}$	F-Stat	P-Value	R^2	Obs
Australia	0.010	0.16	0.15**	0.74	1.40	0.25	0.461	84
Belgium	-0.006	0.23	0.07	0.34	4.25	0.02**	0.414	84
Brazil	-0.011	0.41**	0.11	0.70	0.58	0.56	0.451	84
Canada	0.010*	0.63***	0.06	0.35	5.58	0.01***	0.463	84
China	0.004	0.81***	0.00	0.72	0.70	0.50	0.874	84
Denmark	0.006	-0.07	0.12**	0.14	6.47	0.00***	0.374	84
Finland	0.008	0.00	0.15**	0.21	3.94	0.03**	0.380	84
France	0.008	-0.14	0.15***	0.28	5.60	0.01***	0.460	84
Germany	-0.013**	0.96***	0.14**	0.16	7.28	0.00***	0.572	84
Hong Kong	-0.002	0.50***	-0.07	0.78	0.50	0.61	0.829	84
India	0.000	0.96***	0.17***	0.47	2.18	0.12	0.758	84
Ireland	0.017**	0.78***	0.18**	0.31	5.79	0.01***	0.584	84
Italy	0.009	0.85***	0.15**	0.42	2.67	0.08*	0.566	84
Japan	0.004	0.90***	0.34***	0.89	0.20	0.82	0.666	84
Netherlands	0.002	1.19***	0.12**	0.52	1.83	0.17	0.556	84
Norway	-0.003	0.73***	0.13**	0.51	2.37	0.10	0.648	84
Russia	0.003	0.80***	0.33**	-0.33	1.46	0.24	0.799	67
Singapore	0.004	0.79***	0.05	0.72	0.83	0.44	0.849	84
Spain	0.004	0.37**	0.14**	0.29	4.56	0.01**	0.493	84
Sweden	0.008	0.30*	0.10	0.45	2.80	0.07*	0.575	84
Switzerland	0.002	0.43**	0.13**	0.44	3.16	0.05**	0.584	84
UK	0.004	0.91***	0.07	0.85	0.57	0.57	0.607	84
US	0.009	-0.59*	0.05	0.64	1.72	0.19	0.557	84
Korea	-0.010	0.86***	0.86***	0.92	0.76	0.47	0.825	84

Panel C: Second sub-period (January 2003-December 2010)

Country	α_i	β_i	β_{iKorea}	$\sum_{j=1}^{K}\beta_{ij}$	F-Stat	P-Value	R^2	Obs
Australia	0.006	0.64***	0.09	1.03	0.96	0.39	0.644	84
Belgium	0.007	0.53***	-0.09	0.70	2.12	0.13	0.684	84
Brazil	0.005	1.00***	0.07	1.19	0.71	0.49	0.699	84
Canada	0.003	0.77***	0.07	0.67	2.63	0.08*	0.592	84
China	0.002	0.65***	0.12	1.14	0.58	0.56	0.848	84
Denmark	0.006	0.53***	-0.03	1.17	1.65	0.20	0.705	84
Finland	0.009	-0.11	-0.07	0.95	1.24	0.30	0.718	84
France	0.004	0.41	0.09	1.00	0.49	0.62	0.712	84
Germany	0.001	0.33	-0.06	1.08	0.21	0.81	0.762	84
Hong Kong	0.004	0.46***	-0.07	0.67	2.02	0.14	0.753	84
India	0.000	0.99***	-0.12	0.84	0.31	0.73	0.810	84
Ireland	-0.003	-0.19	-0.13	1.62	1.73	0.19	0.608	84
Italy	-0.003	0.65***	-0.14	0.99	0.19	0.82	0.665	84
Japan	0.000	0.88***	0.18	0.54	3.55	0.04**	0.582	84
Netherlands	-0.002	-0.20	0.07	1.11	0.23	0.80	0.709	84
Norway	0.007	0.92***	0.02	1.18	1.35	0.27	0.689	84
Russia	0.017*	0.78***	-0.41*	1.55	4.65	0.01**	0.690	84
Singapore	0.009**	1.05***	-0.23**	0.82	2.52	0.09*	0.804	84
Spain	0.005	0.56***	-0.01	0.87	0.44	0.65	0.667	84
Sweden	0.007	0.65***	0.06	1.18	2.10	0.13	0.736	84
Switzerland	0.006	-0.10	-0.04	0.89	0.60	0.55	0.574	84
UK	0.003	0.18	0.13	0.82	0.56	0.58	0.641	84
US	0.002	0.46*	0.07	0.86	0.39	0.68	0.644	84
Korea	0.002	0.95***	0.95***	0.67	1.50	0.23	0.750	84

Ⅲ. Demand Estimation of Online Daily Deals using Structural Models[9)]

1. Introduction

Online daily deal sites such as Groupon, which have grown explosively in recent years, allow merchants to gain the attention of online consumers and thereby increase their customer base. 'Deal-of-the-day' websites, a form of electronic commerce, offer time-limited bargain deals with significant discounts—normally 50-90% off—for specific regions. Online daily deal sites send the information on deals to their subscribers via email and short messages, and consequently merchants are introduced to a number of new customers.

Several studies have examined the business model of daily deals from the perspective of coupons (Dholakia, 2011), price discrimination (Edelman et al., 2010), and social learning (Li and Wu, 2012). Wu et al. (2013) find through an analysis of Groupon sales data that purchases increase when the thresholds, that is, the number of deal purchases which are needed to activate the discount, are reached, and thus purchasing of deals becomes more active. Whereas, the study of Subramanian (2012) shows that consumers can wait strategically until the threshold is reached.

We assume that a daily deal site is an online marketplace in that it involves both supply and demand, despite the fact that daily deals differ from traditional commerce sites as they provide bargain deals for limited time. Our goal in this study is to use structural models to

9) This paper is a part of working paper (Attention Economy in Online Daily Deals: Demand Estimation using Structural Models). Co-authors are Seongmin Jeon (Gacheon University), Anindya Ghose (New York University), and Byungjoon Yoo (Seoul National University).

estimate demand for vouchers analyzing the sales dataset of an online daily deal site. We examine how the observed and unobserved characteristics of heterogeneous products and consumers influence the demand for vouchers, specifically the effects of price, discount rate and sales period. The reason we use structural models is that endogeneity issues emerge with the correlations between the errors and observed variables in the reduced form models, since misspecification in general induces non-independent errors. Prices in general are likely to be correlated with the error term in the estimation of demand. Thus, the estimate of the price in this setting would be biased depending on the unobserved product characteristics (Nevo, 2001). Furthermore, daily deals are normally grouped into several predetermined categories, such as restaurants and bars, exhibitions, travel and beauty and spa. Consumer preferences towards the same category are likely to be correlated with one another. This study addresses the price endogeneity issues intrinsic in demand estimation by building random coefficient demand models in line with the BLP (Berry et al., 1995) method. We use the price and sales dataset of one of the largest online daily deal site in Asia for a period of six months. Unlike traditional marketplaces, an increase in length of the sale time period in the online daily deal site is likely to decrease sales.

This paper is organized as follows. Section 2 reviews the literatures associated to theonline daily deal market and attention economics. Section 3 explains what the market share definition is and why we include the sales period in our demand estimation. Section 4 introduces basic statistics of our online daily deal data and explains the estimation models which usually use in industry organization empirical test such as conditional logit and BLP models etc. Section 5 shows the result of empirical test. Section 6 includes the conclusions and discussions.

2. Literature review

Our paper contributes to the literature on the emerging business of online daily-deals. Dholakia (2011) conducted a survey of small businesses partnering with Groupon, and several analytical models with descriptive statistics have been presented to explain daily deal economics and marketing strategy (Edelman et al, 2011; Byers et al., 2012; Kumar and Rajan, 2012; Li and Wu, 2012). Ye et al. (2011) show the dynamic patterns of purchasing times on the websites of Groupon and LivingSocial. Byers et al. (2012) empirically show that a negative side effect for Groupon's merchants is that Yelp ratings decline from the merchants' previous rating as a result of their partnership with Groupon. Li and Wu (2012) and Li (2013) measure the effects of observational learning and word-of-mouth (WOM) using a panel data set and regression discontinuity methods.

The limited time window for voucher sales is closely related with the concept of attention economy, first discussed by Davenport and Beck (2001). Attention becomes the limiting factor in the consumption of information as contents and products have grown increasingly abundant and available. There is an active stream of microeconomic research on how consumer choice is influenced by attention (Masatlioglu et al., 2012). From the viewpoint of sale models, Varian (1980) shows that retail stores decide the period of sales to price discriminate between informed and uninformed consumers. Online daily deals can be understood to behave in order to attract price-sensitive consumers. The empirical study of Pesendorfer (2002) finds that price sensitive consumers tend to wait for the sales, resulting in the increasing sales at the starting point of sales.

Our work is closely related to models of demand estimation in the

differentiated product market. BLP proposes a new model considering the observed and unobserved characteristics of products using only market-level data and dealing with price endogeneity issues (Nevo, 2001). Its applications have been various, including studies on automobiles (Berry et al., 1995), books (Brynjolfsson et al., 2003; Ghose et al., 2006), newspapers (Fan, 2013), personal computers (Song, 2007) and cable TV (Goolsbee and Petrin, 2004). Dube (2004) apply the method to the situation for consumers to purchase multiple products and multiple units. The BLP method has also been adopted widely in demand estimation in IS literature (Ghose and Han, 2011; Ghose et al., 2012; Ghose and Han, 2014).

3. Market share and sales period

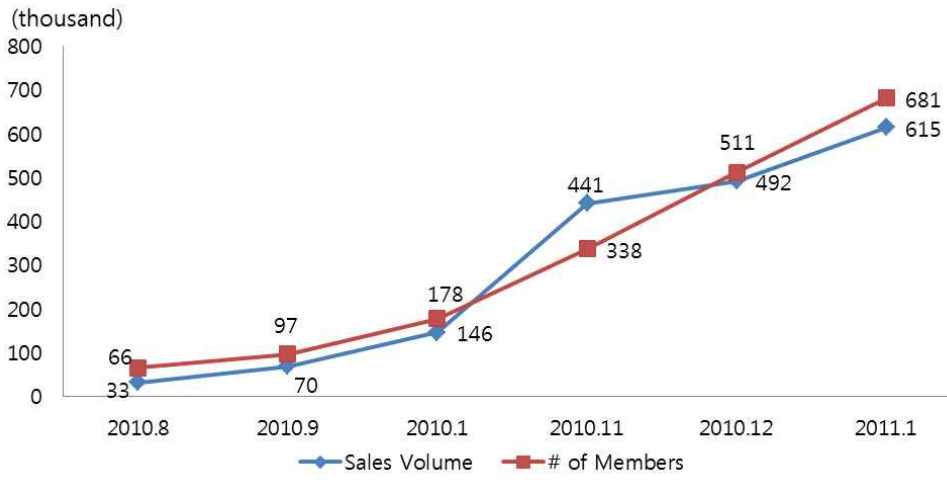
3.1 Definition of Market share

It is important to define market share in multiple choice models in that these models assume that a consumer purchases a product during the given period. Following the approaches of previous literature of structural demand estimation, to define the period is necessary to calculate the market share. We find in our dataset that the number of total sales grows proportionately with the number of members in daily deal market who join in the online daily deals. Figure 1 illustrates that the increasing pattern of the number of members concurs to the number of monthly coupon sales. We come to have an intuition that market is growing as time goes on. At the same time, we could know that members are likely to participate the online daily deal only once a month on average. Some of members are likely to purchase multiple numbers of coupons within a month while others are not likely to

purchase coupons with the interval of a month. If we want to follow the assumption of market share, shorter period of market fit better than longer period. However, daily market couldn't include whole products which we investigate. Therefore, we could define market share to use a week as the period when considering the dataset characteristics. It means that each consumer makes their decision to purchase a coupon within a week. Another advantage when we have the week period is that all the products in categories are sold within a week. This period of a week is also effective to estimate parameters and make instrument variables.

We inevitably accept that the situations violating the assumptions of multiple choice model may happen to exist like the way that the BLP model used to have for their market share. Some of consumers may purchase two or more coupons within a week. The same assumption may apply to the consumers who make decision to purchase two or more cars within the interval of a year. With this idea, we define week as the right period for market share.

Figure 1. Sales Volume and the Number of Members



One thing we would clarify for the market share in our paper is that the definition of market share is different from that of industry reports known well to the public. Normally the industry reports define the market share as the percentage of a company's total sales that is earned by a certain company over a predefined time period. The market share is likely calculated by taking the company's sales over the period and dividing it by the total sales of the industry over the same period (Catry and Chevalier, 1974). The market share may be understood simply as a proportion of a product's sales over week divided by the total sales in the discrete choice model. However, McFadden (1976) define the market share differently as the conditional logit model needs to have alternative zero choice or j_0, where consumers do not choose any product. Likewise, we are expected to take into an account of the outside good when calculating the market share for our estimation. The outside good here is defined as remaining portion of market share other than the coupon sales proportionate to the number of users. To calculate the alternative zero, we set the denominator as the number of potential customers who could be registered users of the online daily deal web site. The market share we define here is the portion of the number of sales a product over the number of registered users per week. As a result, the market share defined in our model could be much smaller compared with the traditional definition of market share.

3.2. Sales period

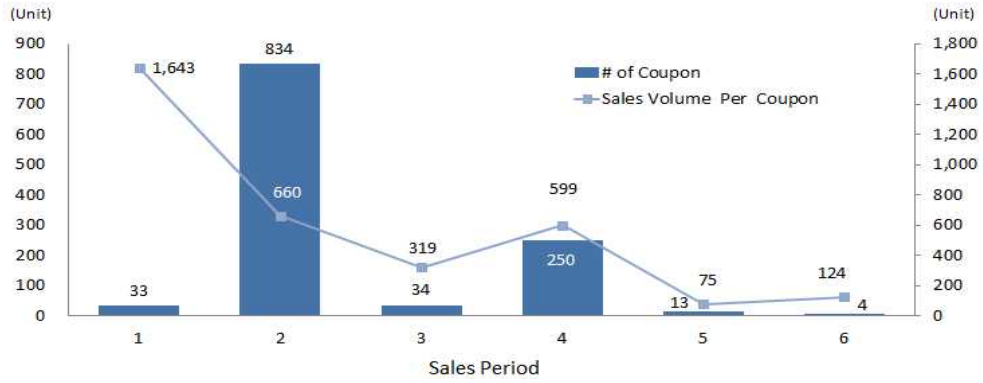
We are interested in the limited time window for voucher sales to affect sales of coupons in this paper because online daily deal markets have the unique feature. One of the crucial factors of online deal

marketplaces is how to catch the eyes balls of customers within the short period of time. Setting the period of sale becomes an important issue for a merchant. We observe the pattern that the average daily sales over the sales period vary. As the sales period increase, we find the tendency that average daily sales reduce as illustrated in Figure 2.

This could be related with the concept of attention economy, first discussed by Davenport and Beck (2001). Attention becomes the limiting factor in the consumption of information as contents and products have grown increasingly abundant and available. We suppose that online daily deal consumer access website daily and search the voucher to buy. If a consumer finds the voucher with the longer sales period, she could postpone the decision to purchase the voucher because she has an opportunity to buy later. That is, the information of longer sales period could make the voucher less attractive. If the total resources of attention are limited, the consumer has to manage necessary resource over the period. In this situation, the voucher with limited time period is likely to attain the consumer's attention.

The concept of search cost is also useful to explain the consumers' behavior. Chen (1997) finds that search cost is an important factor that consumers choose the products and switch the brand they use. The limited time window for voucher in online daily deals induces certain search cost to choose vouchers. If the time to buy a voucher decreases, the search cost is likely to increase. The situation may make consumers find the product with shorter sales period more valuable. Such applications are easily found in the cable TV shopping. The shopping hosts point out limited time offers and the risk of getting sold out. We understand that this type of promotion increases search cost of consumers and prevents consumers from choosing other products.

Figure 2. The Number of Products and Sales Volume per Coupon by Sales Period



4. Data and model

4.1. Data

We use a dataset consisting of list price, discount rate, discounted price, sales quantity, sales period and characteristics data from one of the largest online daily deal sites in Asia. The voucher categories in the dataset are restaurants and bars, exhibitions, travel and beauty and spa. The data set covers the six-month period from August 9, 2010, to January 29, 2011.

We have the sample of 1,164 deals for this study. Market Share is defined by total market size and outside good following the BLP method. In the sample, we assume that discrete choices of consumers are made weekly, while the total market size is inferred from the number of members in the daily deal site. List Price is the list price of deals and ranges from 0 to US$1,000 and averages US$70. Promotional coupons of large franchises tend to be provided either for free or at a low price. Discount Rate represents the discount rate and varies widely from 0% to 99%. However, over 97 percent of deals

offer at least a 50-percent discount. Discounted Price is the price consumers actually pay. Minimum Sale is the specific number of sales units to trigger the discount rate available. The average minimum sale is 98, however, can be as low as 1 and as high as 5,000. Maximum Sale is the number of vouchers available for each deal, ranging from 30 to 99,999. Term of Validity denotes the number of days that purchasers are able to redeem their coupons. The average of Term of Validity is 85, but as low as 1 and as high as 1,826. Sale Period represents the number of days when consumers are able to purchase a coupon. More than 75% of deals are on sale for a maximum of 2 days. Sales Quantity is the number of vouchers sold per deal, ranging from 2 to 49,995.

Deals are classified into categories afterwards. Restaurants account for the largest category with 37%. Beauty and spa have 18%, followed by exhibition with 12%, café with 9%, bar with 8%, travel with 6%, and the remaining categories with 10%.

Table 11. Summary Statistics of Daily Deal Market

Variables	Mean	STD	Min	Max
Market Share	0.005	0.01	0.00	0.17
Discount rate	56.15	8.72	0	99
List price	69.52	114.62	0	1,000
Discounted Price	28.79	54.45	0	599
Sale Period	2.49	1.09	1	20
Term of Validity	85.26	71.17	1	1,826
Minimum Sale	98.49	226.96	1	5,000
Maximum Sale	3,093.23	7,397.13	30	99,999
Sales Quantity	1,543.49	3,395.23	2	49,995
Threshold	0.00	0.04	0	1
Sold-out	0.13	0.34	0	1
Restaurant	0.37	0.48	0	1
Bar	0.08	0.27	0	1
Café	0.09	0.29	0	1
Beauty and spa	0.18	0.38	0	1
Travel	0.06	0.23	0	1
exhibition	0.12	0.33	0	1
etc.	0.10	0.30	0	1

4.2. Econometric model

4.2.1 Conditional Logit Model

McFadden (1976) suggests Conditional Logit Model to estimate demand of multinomial choice model. This structural demand estimation method is very simple and easy to estimate parameters using OLS and two stage regression (IV). Each individual can choose among J alternatives and the utility of consuming alternative J for individual i is given by

$$u_{ijt} = x_{jt}'\beta_i - \alpha p_j + \epsilon_{ijt} = \delta_j + \epsilon_{ijt}, \quad where\ J = 1, ..., j \tag{4}$$

Where x_j is a $K \times 1$ vector of observed product characteristics (including sales period), β_i is a $K \times 1$ vector of random coefficients capturing the individual-specific valuations for the product characteristics, ξ_j refers to unobserved product characteristics and ϵ_{ijt} is a remaining individual-specific valuation for product j. Consumers are assumed to purchase one unit of the good that gives the highest utility. Consumers only differ in ϵ, so the set of people choosing product j is

$$A_j(x, \xi) = \{(\epsilon_{i0}, \epsilon_{i1}, \cdots, \epsilon_{ik} | u_{ij} \geq u_{ik} \ \text{for all}\ k = 0, 1, \cdots, j\} \tag{5}$$

McFadden (1974) showed that if ϵ is i.i.d. and distributed according to a Type I extreme value distribution, i.e., $P^*(\epsilon) = e^{-e^{-\epsilon}}$, then the market share of product j and alternative 0 are

$$s_j = prob(Y=j) = \int_{A_j} dP^*(\epsilon) = \frac{\exp(x_j\beta - \alpha p_j)}{1 + \sum_{k=1}^{J} \exp(x_k\beta - \alpha p_k)} \tag{6}$$

$$s_0 = prob(Y=0) = \int_{A_j} dP^*(\epsilon) = \frac{1}{1 + \sum_{k=1}^{J} \exp(x_k\beta - \alpha p_k)} \tag{7}$$

We define outside alternative 0 as consumer doesn't choose any alternative among possible inside alternatives. For example, it means that a consumer don't buy any coupon among sales coupons. We assume unobservable characteristics of products follow i.i.d.

$$lns_j - lns_0 = x_j\beta - \alpha p_j + \xi_j, \quad where \quad \xi_j \sim N(0, \sigma_\xi) \tag{8}$$

We can calculate the $lns_j - lns_0$ as market share definition and regress it on $x_j\beta$. If there are endogeniety problems, we could use IV (instrument variable) for solving the problems. Although conditional logit model is easy to estimate, it has the Independence of Irrelevant Alternatives (IIA) property.

$$\frac{p_j(x_j)}{p_k(x_k)} = \frac{\exp(x_j\beta - \alpha p_j)}{\exp(x_k\beta - \alpha p_k)} \tag{9}$$

This means relative probabilities for two alternatives depend only on attributes of those two alternatives. The price elasticity of the market shares are

$$\eta_{jk} = \frac{\partial s_j}{\partial p_k}\frac{p_k}{s_j} = \begin{cases} -\alpha p_j(1-s_j) & if \quad j=k \\ \alpha p_k s_k & otherwise. \end{cases} \tag{10}$$

Therefore, we will use BLP(1995) model to avoid this IIA property.

4.2.2 BLP (1995) Model

Berry, Levinsohn, Pakes (BLP) suggested the random coefficient logit model to avoid the limitation of McFadden (1976) methodology. BLP (1995) take into account of unobservable characteristics (ξ_j) of products and random coefficient. The contribution of x_j units of the kth product characteristic to the utility of individual i is $\left(\overline{\beta_j}+\sum\nu_i+\Pi_1 D_{1i}+\Pi_2 D_{2i}\right)x_k$, which varies over consumers. D_1 and D_2 are empirical distribution ages and sex of internet users which also represent unobservable individual characteristics toward product characteristics. We describe D_1 and D_2 distribution in Appendix Ⅱ (Figure 4, 5). These are characteristics' distributions of internet users such as age and sex on Korea Statistical Information Service. We use these distributions for capturing online daily deal consumers' characteristics. However, age distribution is not continuous and is a range variable, so we make it a continuous variable by kernel distribution method with bandwidth 5 and extract the age value from kernel distribution. A sex characteristic simply makes the dummy variable as man is 1 and woman is 0 according to ratio of sex.

$$
\begin{aligned}
& u_{ij} = x_j'\beta_i + \xi_j + \epsilon_{ij} = \delta_j + \mu_{ij} + \epsilon_{ij}, \\
& where\ \delta_j = x_j'\overline{\beta} + \xi_j,\ \mu_{ij} = (x_{jt})(\sum\nu_i + \Pi_1 D_{1i} + \Pi_2 D_{2i}) \\
& \beta_i = \overline{\beta} + \sum\nu_i + \Pi_1 D_{1i} + \Pi_2 D_{2i},\quad D_i \sim P_D^*(D),\ \nu_i \sim N(0, I)
\end{aligned}
\tag{11}
$$

Consumer i chooses good j if and only if

$$
U(\zeta_i, p_j, x_j, z_i, \xi_j; \theta) \geq U(\zeta_i, p_r, x_r, z_r, \xi_r; \theta),\ for\ \zeta_i = (\nu_i, D_1, D_2),\ r = 0,1,\cdots,J \tag{12}
$$

Alternatives $r=0,1,\cdots,J$ represent purchases of the competing differentiated products. Alternative zero represents the option of not purchasing any of those products. The market share of product j and alternative 0 are

$$s_j(p,x,\xi;\theta)=\int_{\zeta\in A_j} P_0(d\zeta)$$
$$A_j \equiv \{\zeta:\ U(\zeta_i,p_j,x_j,z_i,\xi_j;\theta) \geq U(\zeta_i,p_r,x_r,z_i,\xi_r;\theta)\ for\ r=0,1,\cdots,J\} \tag{13}$$

A_j is the set of values for ζ that induces the choice. $P_0(d\zeta)$ provides the density of ζ in the population and the market share of good j as a function of the characteristics of all the goods competing in the market. The price elasticity of the market shares are

$$\eta_{jk}=\frac{\partial s_j}{\partial p_k}\frac{p_k}{s_j}=\begin{cases}-\dfrac{p_j}{s_j}\displaystyle\int \alpha_i s_{ij}(1-s_{ij})d\widehat{P}_D^*(D)d\widehat{P}_\nu^*(\nu) & if\ \ j=k\\ -\dfrac{p_j}{s_j}\displaystyle\int \alpha_i s_{ij}s_{ik}d\widehat{P}_D^*(D)d\widehat{P}_\nu^*(\nu) & otherwise.\end{cases} \tag{14}$$

$$where\quad s_{ij}=\frac{\exp(\delta_j+\mu_{ij})}{1+\sum_{k=1}^{K}\exp(\delta_k+\mu_{ik})}$$

This could solve McFadden (1976)'s IIA property. This price elasticity of the market shares can differentiate characteristics of products. The partial derivative of the market shares will no longer be determined by a single parameter α. Instead, each individual will have a different price sensitivity which will be averaged to a mean price sensitivity using the individual specific probabilities of purchase as weights. The price sensitivity will be different for different

characteristics. Therefore, substitution patterns are not driven by functional form, but by the differences in the price sensitivity, or the marginal utility from ages, between consumers that purchase the various products.

4.2.3 Modified BLP Model

Berry and Pakes (2007) criticizes the BLP (1995) estimation because the estimated model will imply that as we increase the number of products each individual's utility increases to infinity as number of new products grows, regardless of the observed characteristics of either the products that enter or of the individual due to ϵ_{ij}. Therefore, Berry and Pakes (2007) suggest pure characteristics demand model without ϵ_{ij} and modified BLP which uses $\sigma_\epsilon \epsilon_{ij}$. Modified BLP can takes advantages of BLP and avoid the disadvantage of BLP. One is to reduce speed of estimation and market share can be easily inverted to solve for the unobservable characteristics ξ_j as a linear function of the parameters and the data, enabling the use of instrumental variable techniques to solve simultaneity problem induced by correlation between the unobserved characteristics and price. Utility function of modified BLP introduces the additional parameter σ_ϵ and then assume

$$u_{ij} = x_j' \beta_i + \xi_j + \sigma_\epsilon \epsilon_{ij} = \delta_j + \mu_{ij} + \epsilon_{ij},$$

$$\begin{aligned} where\ \delta_j &= x_j' \overline{\beta} + \xi_j,\ \mu_{ij} = (x_{jt})(\sum \nu_i + \Pi_1 D_{1i} + \Pi_2 D_{2i}) \\ \beta_i &= \overline{\beta} + \sum \nu_i + \Pi_1 D_{1i} + \Pi_2 D_{2i}, \quad D_i \sim P_D^*(D),\ \nu_i \sim N(0, I) \end{aligned} \tag{15}$$

The model with tastes for products is the special case of Equation (7) with $\sigma_\epsilon = 1$ whereas the pure characteristic model is the special

case with $\sigma_\epsilon = 0$. Berry and Pakes (2007) assume $\sigma_\epsilon > 0$ so that we can define $\mu_\epsilon \equiv \sigma_\epsilon^{-1}$ and multiply all utilities by it. We can use probability of i choose j such as

$$s_{ij} = \int \frac{\partial s_j}{\partial p_k} \frac{p_k}{s_j} = \begin{cases} -\alpha p_j (1 - s_j) & if\ j = k \\ \alpha p_k s_k & otherwise. \end{cases}, \quad \mu_\epsilon \equiv \sigma_\epsilon^{-1} \tag{16}$$

4.2.4 Random Coefficient Nested Logit (RCNL) Model

Our model also use the random coefficients nested logit (RCNL) model effective in estimating demand of the products grouped into predetermined categories. Utility function is defined as below following the identification of observed variables for products and consumers. Then we use the RCNL model derived by Grigolon and Verboven (2011). The RCNL combines the random coefficient logit model (BLP) and the nested logit model. In t market $(t = 0,1,\cdots, T)$, each consumer i may either choose the outside good 0 or j differentiated product $(j = 0,1,\cdots, J)$. The random coefficients vector, β_i, can be specified as follows:

$$u_{ij} = x_j' \beta_i + \xi_j + \bar{\epsilon}_{ij} = \delta_j + \mu_{ij} + \zeta_{igt} + (1-\rho)\epsilon_{ij}$$

$$where\ \delta_j = x_j' \bar{\beta} + \xi_j,\ \mu_{ij} = (x_{jt})(\sum \nu_i + \Pi_1 D_{1i} + \Pi_2 D_{2i}),\ \bar{\epsilon}_{ij} = \zeta_{igt} + (1-\rho) \tag{17}$$
$$\beta_i = \bar{\beta} + \sum \nu_i + \Pi_1 D_{1i} + \Pi_2 D_{2i},\quad D_i \sim P_D^*(D),\ \nu_i \sim N(0, I)$$

This model can assign each product j to a group g $(g = 0,1,\cdots, G)$. The groups are collectively exhaustive and mutually exclusive, and group 0 is reserved for the outside good 0. The ϵ_{ijt} has i.i.d extreme value and consequently, ζ_{igt} can be interpreted as random coefficients

on group-specific dummy variable follows the unique distribution. The parameter ρ is a nesting parameter $(0 \leq \rho \leq 1)$, and can be interpreted as a random coefficient proxying for the degree of preference correlation between products of the same group. As ρ approaches one, the within-group correlation of utilities approaches one, and consumers perceive products of the same group as perfect substitutes relative to other products. As ρ moves toward zero, so does the within-group correlation, and the model reduces to the simple logit. If $\sum$ and Π are zero vector, we obtain the standard nested logit model. If $\rho = 0$, the within-group correlation becomes zero, and consequently the model turns to be the BLP random coefficient logit model. If $\sum$, Π and ρ are all zero or zero vector, it will be a simple logit model.

Each consumer i in market t chooses the product j that maximizes her utility. The aggregate market share for product j in market t is the probability that product j yields the highest utility across all products (including the outside good 0). The predicted market share of product $(j = 0,1,\cdots, J)$ in market t, as a function of the mean utility vector δ_t and the parameter vector $\theta = (\beta, \sigma, \pi, \rho)$, is the integral of the nested logit expression over the standard normal random variable vector ν_i and D_i.

$$s_{ij} = \int_{\nu, D} \frac{exp\ \left((\delta_j + \mu_{ij})/(1-\rho)\right)}{exp\ \left(I_g/(1-\rho)\right)} \frac{exp I_{ig}}{exp I_i} dP_\nu^*(\nu) dP_D^*(D) \qquad (18)$$

where I_{ig} and I_i are McFadden's (1978) "inclusive values" defined by

$$I_{ig} = (1-\rho) ln\ \sum_{j=1}^{J_g} exp\ \left(\frac{\delta_j + \mu_{ij}}{1-\rho}\right), \quad I_i = ln\ \left(1 + \sum_{g=1}^{G} \exp(I_{ig})\right)$$

4.3 Estimation Method

4.3.1 Calculation of Market Share

To estimate the demand parameters θ, we need to calculate market share which we defined. Market shares are different depend on the models such as Conditional Logit (McFadden, 1976), BLP (Berry et al., 1995), Modified BLP (Berry and Pakes, 2007), RCNL (Grigolon and Verboven , 2011). Each market shares are calculated by numerically beside Conditional Logit. We approximate the integral over ν_i and D_i by simulating that R draws over the density of ν *and* D_1, D_2.

Conditional Logit (McFadden, 1976)

$$s_j = \frac{exp(\delta_j)}{1+\sum_{k=1}^{J} exp(\delta_i)} \tag{19}$$

BLP (Berry et al., 1995)

$$s_j = \frac{1}{ns}\sum_{i=1}^{ns}\frac{exp(\delta_j+\mu_{ij})}{1+\sum_{k=1}^{J} exp(\delta_i+\mu_{ik})} \tag{20}$$

$$where\ \delta_j = x_j'\overline{\beta}+\xi_j,\ \ \mu_{ij} = (x_{jt})(\sum\nu_i + \Pi_1 D_{1i} + \Pi_2 D_{2i})$$

Modified BLP (Berry and Pakes, 2007)

$$s_j = \frac{1}{ns}\sum_{i=1}^{ns}\frac{exp\ \left((\delta_j+\mu_{ij})\mu_\epsilon\right)}{1+\sum_{k=1}^{J}exp\left((\delta_j+\mu_{ij})\mu_\epsilon\right)} \tag{21}$$

$$where\ \delta_j = x_j'\overline{\beta}+\xi_j,\ \ \mu_{ij} = (x_{jt})(\sum\nu_i + \Pi_1 D_{1i} + \Pi_2 D_{2i})$$

RCNL (Grigolon and Verboven , 2011)

$$s_j = \frac{1}{ns}\sum_{i=1}^{ns}\frac{exp\ \left((\delta_j+\mu_{ij})/(1-\rho)\right)}{exp(I_g/(1-\rho))}\frac{exp I_{ig}}{exp I_i} \tag{22}$$

$$where\ \delta_j = x_j'\overline{\beta}+\xi_j,\ \ \mu_{ij} = (x_{jt})(\sum\nu_i + \Pi_1 D_{1i} + \Pi_2 D_{2i})$$

$$I_{ig} = (1-\rho)ln\ \sum_{j=1}^{J_g}exp\left(\frac{\delta_j+\mu_{ij}}{1-\rho}\right),\ \ I_i = ln(1+\sum_{g=1}^{G}exp(I_{ig}))$$

4.3.2 Estimation steps

As we describe, market share is needed to integrate out over ν, D_1, D_2 distribution numerically. Next, we have to combine our estimates of the market share function with the observed market shares to solve for δ as a function of θ. Firstly, we set initial mean utility δ^0, then we can use contraction mapping as

$$\delta_j^{h+1} = \delta_j^h + lns_j^n - ln\ \left[s_j\left(\delta_j^h, x, \mu, \theta, P_{ns}\right)\right] \tag{23}$$

If $lns_j^n > ln\ \left[s_j\left(\delta_j, x, \mu, \theta, P_{ns}\right)\right]$, then it will increase the update δ_j^{h+1} and then repeat this update until convergence. We equate the observed market

share vector to the predicted market share vector, $s_t = s_t(\delta_t, \theta)$. Since the error term enters additively in δ_t, this gives a solution for the error term ξ_{jt} for each product j in market t. We then interact this with a set of instruments Z providing the moment conditions to proceed with GMM. We could estimate the parameters by minimizing the GMM object function. We basically use GMM based on the moment condition $E(\xi|z) = 0$, which implies

$$E(\xi|z) = 0 \Rightarrow \frac{1}{j}\sum_{j=1}^{J}\xi_j z, \;\; \xi_j = \delta_j - x_j'\overline{\beta} \tag{24}$$

Define $G_j(\theta)$ as

$$G_j(\theta) = \begin{bmatrix} \frac{1}{J}\sum_{j=1}^{J}\left(\delta_j(\theta) - x_j\overline{\beta}\right)z_{1,j} \\ \vdots \\ \frac{1}{J}\sum_{j=1}^{J}\left(\delta_j(\theta) - x_j\overline{\beta}\right)z_{N,j} \end{bmatrix} \tag{25}$$

Where $z_j' = (z_{1j}, \cdots, z_{Nj})$ and N is the number of instruments. We use efficient Weight Matrix $W_j = (z'z)^{-1}$, then GMM can be then implemented by

$$\min_{\theta} Q(\theta) = G_j(\theta)' W_J G_J(\theta), \mathrm{W_j} = (Z'Z)^{-1} \tag{26}$$

4.4 Instrument variable

In an effort to deal with endogeneity issues, we specify instruments for the demand equations. Prices are likely to be related with the unobserved characteristics of products, such as service, quality and brand (Nevo, 2001). To separate the endogenous variation, we use

instruments that are related with prices and not related with product characteristics. We consider using the instruments used in previous research (Berry et al., 1995; Nevo, 2001). For product j, we use prices and characteristics of other products in the market excluding productj as instrument variables. Those variables are not likely to be related with unobserved characteristics. However, they are likely to be associated with product j's observed characteristics including price. Therefore, we consider instrument variables such as the average prices, the average discount rates, the average sale periods and the average validity terms of other products in the market besides product j. These variables are expected to be associated not with unobserved characteristics but with prices.

5. Results

In order to check the robustness, we present three sets of results presented in Table 12 (OLS, IV, BLP) and robust test results in Appendix Ⅱ Table 14, 15 (Modified BLP, RCNL). OLS and IV regressions reflect conditional logit model followed by McFadden (1976) and The BLP reflects random coefficient model by Berry, Levinsohn, Pakes (1995), representing consumer's different tastes toward individual product attributes. The modified BLP model reflects the pure characteristics proposed by Berry and Pakes (2007), representing consumers' different tastes without considering the tastes for certain products as a whole. According to Song (2011), product-level "taste shock" is related with the context of the market. The modified BLP model reflects the levels of consumer heterogeneity brought on by different product categories and characteristics. Lastly, Our model also

use the random coefficients nested logit (RCNL) model effective in estimating demand of the products grouped into predetermined categories derived by Grigolon and Verboven (2011).

To sum up the results of the structural models, most of the coefficients' signals and significances are consistent across the models. We easily infer that the discount rate has a positive impact on voucher demand. Discounted price and sale period have a negative impact on voucher demand. Here, we have solid arguments for including excluded characteristics, as the coefficient for sale period increases as a result of our explicit treatment of product characteristics unobserved by the researcher but known to consumers in the market. In other words, deals with a long sale period are not as likely to attract consumers as are deals with a short sale period. Consumers may have more chances to purchase vouchers with a "short opportunity window" or as an impulse purchase, as a majority of deals end within 2 days. Terms of validity and minimum sale have a positive effect on voucher demand. The results for the dummy variables of threshold illustrate that reaching the threshold for the realization of the discount price is not a statistically significant factor on the demand.

Table 12. Results with OLS, IV, BLP

This tables show results of regressions such as conditional logit models of OLS, IV (McFadden, 1997) and random coefficient model (BLP, 1995). The standard errors reported in parentheses. ***, **, and * denote the 1%, 5%, and 10% significance levels, respectively.

Variable	OLS	IV	BLP			
			$\bar{\beta}$	$\sum$	π_1	π_2
Intercept	-4.883*** (0.2026)	-4.150*** (0.3855)	-11.4202*** (0.0644)	1.1069*** (0.0143)	0.01949*** (0.0021)	0.2196*** (0.0003)
Discount Rate	0.013*** (0.0032)	0.013*** (0.0034)	0.0130*** (0.0011)	0.0066 (0.0060)	0.00042*** (0.0000)	0.0065*** (0.0005)
Discounted Price	-0.007*** (0.0005)	-0.007*** (0.0006)	-0.0823*** (0.0022)	0.0139*** (0.0021)	0.00058*** (0.0000)	0.0013 (0.0008)
Sale Period	-0.009 (0.0329)	-0.299** (0.1296)	-0.0691*** (0.0259)	0.0883*** (0.0060)	0.00272*** (0.0006)	0.1268*** (0.0015)
Term of Validity	0.001*** (0.0004)	0.001*** (0.0004)	0.0022*** (0.0008)	0.0000 (0.0072)	0.00001 (0.0000)	0.0003 (0.0011)
Minimum Sale	0.001*** (0.0001)	0.001*** (0.0001)	0.0052*** (0.0007)			
Maximum Sale	0.000*** (0.0000)	0.000*** (0.0000)	0.0000 (0.0000)			
Threshold	-2.149*** (0.5933)	-2.128*** (0.6361)	0.0000 (28.6727)			
Sold-out	0.240*** (0.0722)	0.237*** (0.0774)	-0.2827 (0.4722)			
Category Control	yes	yes	yes			
Region Control	yes	yes	yes			
Week Control	yes	yes	yes			
adj R-sq.	0.5809	0.54698	GMM-Obj.		7.02E-05	
# of Obs	1164	1164	# of Obs		1164	

According to the results from the BLP model of Table 3 considering product and consumer characteristics, we estimate that, for a product with an average market share, a one percent extension in the sale period is associated with a decrease in voucher demand by

0.37%. A one percent extension in validity period is associated with an increase in demand by 0.04%. A one per cent increase in the price is associated with a decrease in demand by 1.42%, whereas one percent increases in the number of discount rate, minimum sales and maximum sales are associated with increases in demand by 0.87%, 0.39% and 0.35%, respectively. Cross elasticity results show that a one percent extension in the sales period of a competitive product with the same market share is associated with an increase in voucher demand by 0.0019% on average while a one percent extension in the validity period of a competitive product with the same market share is associated with a decrease in demand by 0.0002%. A one percent increase in the price of the competitive product with market share is associated with an increase in demand by 0.0071%, whereas one percent increases in the number of discount rate, minimum sales and maximum sales of a competitive product with the same market share are associated with decreases in demand by 0.0044%, 0.0019% and 0.0018%, respectively. Furthermore, we investigate the single category samples in order to deal with the issues from the assumption of RCNL that each consumer only purchases one product out of the market. Using the samples of restaurant category, we find that the results confirm our findings with the multiple category samples.

One of most practical benefits of structural modeling is that it can provide counter-factual experiments to help in making decisions. We have presented some results which are of interest to merchants after conducting several counter-factual experiments in Figure 3. To identify the effects of the sales period, we assume a sale period of 1 to 5 days, as we know that more than 99 percent of deals are sold within a 5-day sale period. All else being equal, a one-day extension of sales will decrease the product's weekly market share by 15.1%. The results from the counter-factual experiments on the sales period are illustrated

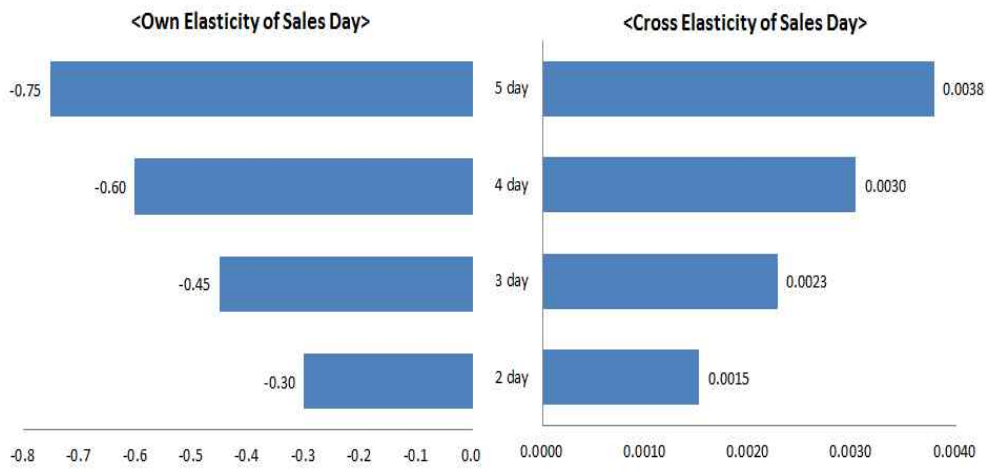
in Figure 3. Additionally, we assume discount rates of 50%, 60%, 70%, 80% and 90%, as we know that more than 97 percent of deals offer at least a 50% discount. Then, we examine subsequent demand changes in each case through the counter-factual experiments. An extra 10% discount for vouchers with average market share will result in additional demand of approximately 15.5%.

Table 13. Own & Cross Elasticity of products

We calculate own and cross elasticity of products by using McFadden (1973)'s simple equation $\eta_{jk} = \frac{\partial s_j}{\partial p_k}\frac{p_k}{s_j} = \begin{cases} -\alpha p_j(1-s_j) & if \quad j=k \\ \alpha p_k s_k & otherwise. \end{cases}$ where α is coefficients and s_j is market share that we assume average market share 0.005.

Variables	Coefficient	Mean	Own-Elasticity	Cross-Elasticity
Discount Rate	0.0156	56	0.87	-0.0044
Discounted Price	-0.0496	29	-1.42	0.0071
Sale Period	-0.1515	2	-0.37	0.0019
Term of Validity	0.0005	85	0.04	-0.0002
Minimum Sale	0.0039	98	0.39	-0.0019
Maximum Sale	0.0001	3,092	0.35	-0.0018

Figure 3. Counter-factual Experiment Results of Sales Day



6. Conclusions and discussions

In this paper, we estimate demand for online daily deal vouchers redeemable at various places in categories such as restaurants and bars, travel, exhibitions and beauty and spa. We use structural models to analyze the actual transactional data set of an online daily deal site, considering both the product characteristics and the heterogeneous consumer attributes. We estimate demand using BLP, modified BLP and RCNL models, to find the counter-intuitive results that a longer sales time is likely to decrease sales unlike the traditional marketplaces. All else being equal, a one-day extension of sales is estimated to decrease the product's weekly market share by 15.1%. We infer that attention economy exists in online daily deals from the viewpoint that limited time offers draw consumers' attention and consequently lead to additional sales. The concept of search cost is also useful to explain the consumers' behavior (Chen, 1997). The limited time window for voucher induces certain search cost to choose vouchers. Our analysis provides a practical implication that the best strategy for revenue maximization inferred from our models is that merchants on daily deal sites would rather have high discount rates and short sales period if other things are equal.

Our work still has many areas which can be improved upon in future studies. We should extend to a more thorough analysis of the attention economy effects. The empirical analysis undertaken in this study is not able to establish a model that consumers narrow down their choices of online daily deals and then make a purchase decision from the funneled choices as we could not analyze user-level data sets. In spite of these limitations, as an empirical study using structural models to demand estimation in electronic marketplaces, our paper can pave the way for future research in this exciting domain.

Appendix Ⅱ

Figure 4. Kernel Distribution of Internet User Ages in Korea

(Source: Korea Statistical Information Service)

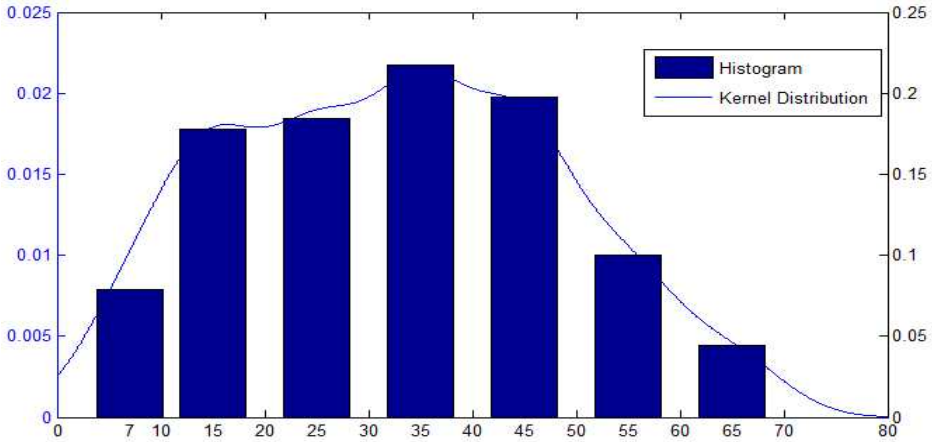


Figure 5. Probability of Sex in Internet User in Korea

(Source: Korea Statistical Information Service)

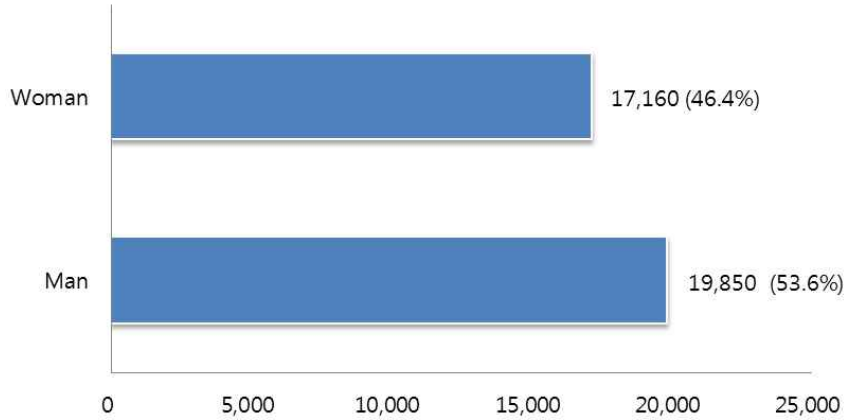


Table 14. Robust Test with Modified BLP

This table shows a robust test result using Modified BLP models (Song, 2011) The standard errors reported in parentheses. ***, **, and * denote the 1%, 5%, and 10% significance levels, respectively.

Variable	Modified BLP			
	$\overline{\beta}$	$\sum$	π_1	π_2
Intercept	-11.4202*** (0.0644)	1.1069*** (0.0143)	0.01949*** (0.0021)	0.2196*** (0.0003)
Discount Rate	0.0130*** (0.0011)	0.0066 (0.0060)	0.00042*** (0.0000)	0.0065*** (0.0005)
Discounted Price	-0.0823*** (0.0022)	0.0139*** (0.0021)	0.00058*** (0.0000)	0.0013 (0.0008)
Sale Period	-0.0691*** (0.0259)	0.0883*** (0.0060)	0.00272*** (0.0006)	0.1268*** (0.0015)
Term of Validity	0.0022*** (0.0008)	0.0000 (0.0072)	0.00001 (0.0000)	0.0003 (0.0011)
Minimum Sale	0.0052*** (0.0007)			
Maximum Sale	0.0000 (0.0000)			
Threshold	0.0000 (28.6727)			
Sold-out	-0.2827 (0.4722)			
Category Control	yes			
Region Control	yes			
Week Control	yes			
adj R-sq.	5			
# of Obs	1164			
GMM Obj	4.33E-11			

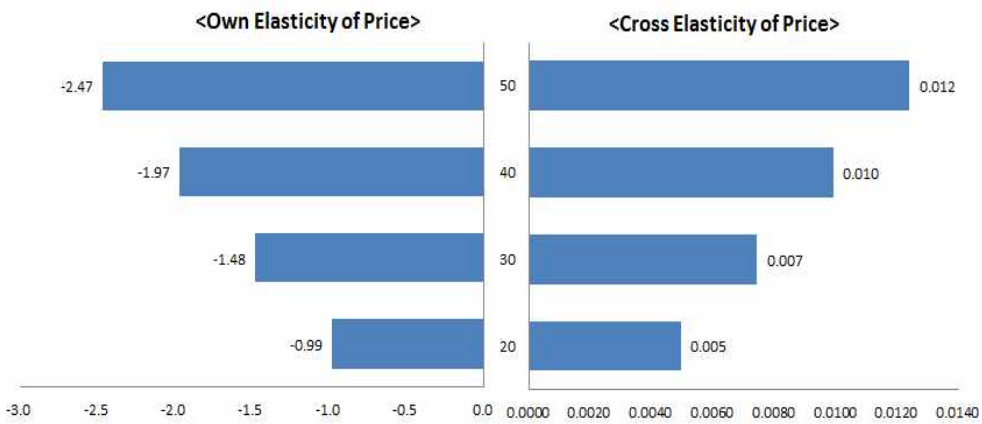
Table 15. Robust Test with Random Coefficient Nested Logit (RCNL)

This table shows a robust test result using Random Coefficient Nested Logit (Grigolon and Verboven, 2011). The standard errors reported in parentheses. ***, **, and * denote the 1%, 5%, and 10% significance levels, respectively.

Variable	Random Coefficient Nested Logit(RCNL)			
	$\bar{\beta}$	$\sum$	π_1	π_2
Intercept	-7.2583*** (0.0662)	1.0654*** (0.0063)	0.00365** (0.0016)	0.5764*** (0.0002)
Discount Rate	0.0156*** (0.0012)	0.0060* (0.0035)	0.00059*** (0.0000)	0.0058*** (0.0004)
Discounted Price	-0.0848*** (0.0023)	0.0136*** (0.0016)	0.00052*** (0.0001)	0.0023*** (0.0005)
Sale Period	-0.0893*** (0.0268)	0.0993*** (0.0027)	0.00257*** (0.0005)	0.1150*** (0.0008)
Term of Validity	0.0019** (0.0008)	0.0000 (0.0029)	0.00001 (0.0000)	0.0003 (0.0008)
Minimum Sale	0.0045*** (0.0007)			
Maximum Sale	0.0000 (0.0000)			
Threshold	0.0000 (29.7933)			
Sold-out	-0.4997 (0.4851)			
Category Control	yes			
Region Control	yes			
Week Control	yes			
adj R-sq.	0.126			
# of Obs	1164			
GMM Obj	1.12E-09			

Figure 6. Counter-factual Experiment Results of Discount Rate

Figure 7. Counter-factual Experiment Results of Price



IV. Analysis on the Effect of Macroeconomic Factors to Credit Card Interest Rate

1. Introduction

Global credit card market has grown consistently. According to nilson report, amount of credit card payment through credit card network companies (Visa, MasterCard, Unionpay, American Express, JCB, Diners Club, Discover) has increased by fifth times from 490 trillion won[10] on 2003 to 2,378 trillion won on 2014 for 20 years. Korea credit card market has also grown explosively due to government stimulation policy such as income deduction, card receipt lottery etc. The credit card is very important financial service industry in korean because the amount of credit card payment accounts for 70 percent of private consumption and expenditure on 2014. However, researches of this field are not active compared to banks, securities and asset management industry and mostly are concentration on U.S. market. These papers examine why credit card interest rates such as cash advance and card loan are sticky and high (Ausubel (1991), Zwicki (2000), Calem and Mester (1995), Stango (2002), Cargill and Wendel (1996), Mester (1994), Brito and Hartly (1995)). There are also several papers dealt with credit card market of korea which analyze the reasons of stickiness and high interest rate by using theoretical and empirical methods (Kim (2002), Song (2005), Park and Ko (2010)). However, it is true that there are lack of researches dealing with credit card interest rate. Therefore, I study the korea credit card interest rate to widen knowledge of financial market and find the proper policy implication. Previous papers explain high interest rate as

10) Won-dollar exchange rate is 1,000 won.

consumer's irrationality and lack of competition of credit card companies. However, sticky and high credit card interest rates are explained by adverse selection and moral hazard assuming card holder's rationality and competition industry. Ausubel (1991) insisted that card holder's irrationality and low competition of credit card industry were the reasons to be high interest rate of credit card. However, Zwicki (2000) thought interest rate could be high and sticky due to adverse selection and moral hazard even thought we assume card holders are rational and the market is very competitive against Ausubel (1991)'s insistence. Papers after Ausubel (1991) have done empirical studies of moral hazard and adverse selection through funding, searching, and switching cost under rationality and competition market (Mester (1994), Calem and Mester (1995), Ayadi (1997), Morgan and Tool (1997), Stango (2002)). Beside these papers, there are several papers that explained credit card interest rate by non-price factors and option model (Pozdena (1991), Canner and Luckett (1992), Cargill and Wendel (1996), Park (1997, 2004), Akin et al. (2009)).

This study analyzes the effect of macroeconomic factors to credit card interest rate such as cash advance and card loan. Macroeconomic factors represent household default risk such as household debt ratio, seasonal adjusted real GDP and unemployment rate. Credit card loan is usually borrowed by low credit rating person compared to bank loan, so it is important to predict and measure the probability of default. I will derive a model that default probability affects credit card interest rate directly. This model develops Stango (2002)'s switching cost model under information asymmetric which stems from Chen (1997). Stango (2002) shows that switching cost makes credit card interest rate increase. By combining Stango (2002) and household default probability, I show the default probability is the factor of increasing

the credit card interest rate in the model. This paper do panel regressions to test that macroeconomic variables affect the interest rate. Credit card loan is different from bank loan system in Korea, so we try to predict default probability by using macroeconomic variables. Credit card holders may use card loan services due to convenient or lack of credit because credit card loan systems don't have collaterals and paper works banks usually ask customers to do. These factors make credit card issuers sensitive to household default risk. The issuers can only see the micro customer's private information such as card spending pattens and card debt balance etc., and credit scoring data from credit Bureau. These data aren't enough to identify customers' credit, so issuers need to look up the macroeconomic variables which represent overall economic situation.

We analyzes the effect of macroeconomic variables, related to default risk, on credit card interest rate. This paper is organized as follows. Section 2 introduces regulation changes and status of credit card interest rate in Korea. Section 3 studies previous researches. Section 4 and 5 suggest theoretical and empirical models. Lastly, section 6 explains main results in this paper.

2. Regulation changes and status in Korea

2.1. Regulations related to credit card interest rate

There are six card debt category such as cash advanced, installment loan, card loan, revolving, delinquent interest rate. Installment loan is applied by installment transaction act, and yearly interest rates are limited by interest limitation act in installment transaction act article 7. Beside installment loan, credit card interest rate is applied by "Act on registration of credit business, etc. and

protection of finance users“, so called Usury act in U.S. Therefore, credit finance companies (credit card[11], capital company, installment finance and leasing companies) are restricted by interest cap of Usury Act article 9 in Korea.

Table 16. Credit Card Interest Rate Category

Categories		Applied Law
Cash advance		Usury Act[1]
Installment loan		Installment transaction act
Card loan		Usury Act
Revolving	Lump-sum payment(Payment type)	Usury Act
	Cash advance(Loan type)	Usury Act
Delinquent interest rate		Usury Act

Note : 1) Called “Act on registration of credit business, etc. and protection of finance users” in Korea

Interest limitation act and Usury act are established in 1996 and 2002 respectively, and these acts limit the interest cap which is changed depending on economic situation, legislature body and administration policy.[12] When Korea went through the foreign exchange crisis, interest cap was abolished to reduce capital outflow due to low interest rate. Until foreign exchange crisis and establishing Usury act, interest cap in interest limitation act had fluctuated between minimum 20% and maximum 40%. However, interest limitation act was abolished in 1998 and then Usury act was established in 2002. Registered credit finance companies and unregistered lender was applied by 66% interest cap according to Usury act. Since then, interest cap has continuously decreased to 34.9% in July, 2014. Abolished interest limitation act was reestablished by new interest limitation act in 2007 and interest cap was set by 30%, but it was lowered by 25% in July, 2014. Credit card interest rate is usually

11) In korea credit card issuers operate both of issuer and network company whose system is called by third party system different from fourth party system in U.S.
12) Refer to appendix Ⅲ

higher than bank loan, so it's easy to be affected by interest cap abided by Interest limitation and Usury act. Therefore, we need to understand the regime of interest cap when analyzing the determinants of credit card interest rate.

Nowadays, financial authority assessed credit card market as there is no principle and standard system to determine interest rate and also lack of transparency. Therefore, they made guidelines of setting the loan interest rate in Aug, 2013.[13] Main objects are to suggest a system of cost compositions, to execute internal control, and to strengthen the right of borrowers. Especially, financial authority suggested the method of calculating interest rate on loan which should be determined by basic cost, margin (target profit rate), adjusted cost of fund. The basic cost is composed of credit, operating, funding, capital cost. As providing detailed principle to determine credit card interest rate which was autonomous under Interest limitation act and Usury act, it could be affected by category of basic cost in method. However, there are various structures of basic cost depending on issuer's types such as mixed bank and credit card only. It is difficult for mixed bank to identify basic cost of credit card business because a bank usually shares the loan system along with credit card issuers in Korea.

Table 17. Calculation Method of Basic Cost

Category	Contents
Credit cost	Predicted default rate and loss rate of default
Operating cost	Operating cost related to loan is consist of labor and rent cost etc.
Funding cost	Consider the methods of funding
Capital cost	Composed of Credit risk capital ratio and equity funding cost

Note : Financial Services Commission (2013)

13) Financial Services Commission (2013)

2.2. Credit card interest rate trend

This paper investigates the determinants of cash advance (short term) and card loan (long term) interest rate. Cash advance is usually higher than card loan interest rate. Cash advance has 1~2 months credit offering period, but card loan has 3~36 months longer credit offering and condition to redeem by installment. The systems of two interest rate are also different. Card loan is usually from a bank affiliated with a credit card issuers as a business, but cash advance is to withdraw cash from ATM directly with credit card account. These differences make credit card interest rate different. Despite it, they have common grounds to borrow without collateral and to lower the credit score when customers use credit card loan. These characteristics give rise to gather customers of low credit rating rather than high.

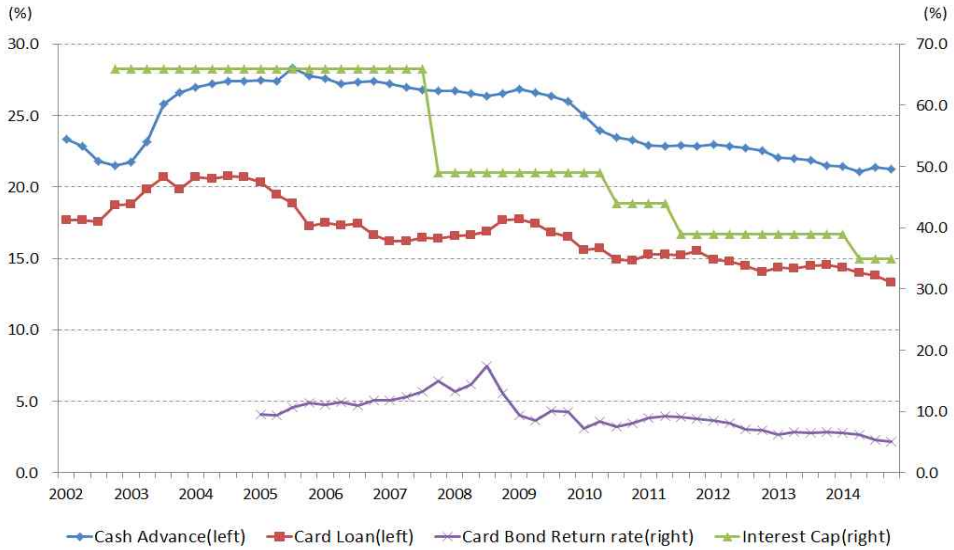
Credit card interest rates have been lowered continuously except during 2004~2005. It seem to be that the interest rates comove with interest cap under Usury act. Therefore, we think interest rate of credit finance industry could be affected by financial authority policy. Credit card interest rates on average are below the interest cap, but interest rate of low credit rating customers could be over the cap. Funding cost[14] is much below the card interest rates we analyze. It had increased from 2005 to 2008 (global financial crisis), but after global financial crisis, many countries have reduced central bank's base rate to prevent from economic recession. It have induced credit card bond rate[15] (funding cost) reduced.

---

14) Return rate of credit card issuers' bonds which have 3 month, 6 month, 1~20 years maturity. We will use 3 month and 1 year maturity bond.

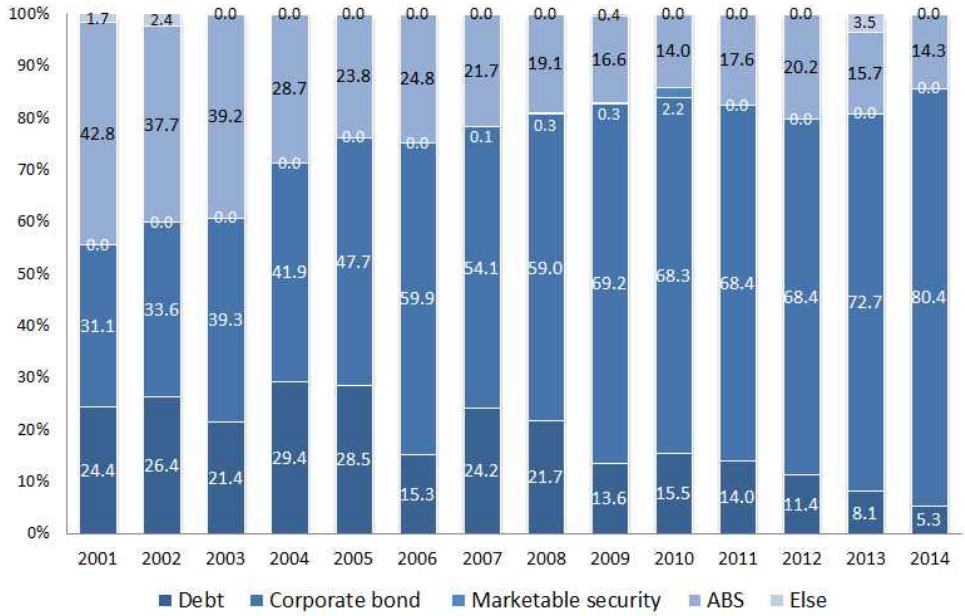
15) We assume that return rate of corporate bond, credit card bond, is cost of fund.

Figure 8. Trend of Card Interest Rate, Bond Return Rate and Interest Cap



When we see the funding methods of credit card issuers since 2001, Proportion of corporate bond have get larger, but ABS (Asset Backed Securities) and bank loan have been lowered. There was credit card crisis during 2002~2003 in Korea due to irrational marketing competition among credit card issuers. It was harsh time for the issuers to survive, so card ABS was banished in the market. Delinquent rate was over 14% among card payment in the end of 2003 started from 2002. Delinquent borrowers over 1 month in financial industry had increased rapidly from 1.4 million in 1997 to 3.6 million in 2004. Especially delinquent borrowers was increased by 1.1 million during 2003. According to proportions of funding methods, it is reasonable to choose the corporate bond as main funding source of issuers in this paper. Amount of funding from corporate bond have increased 39 trillion won (80.4%) in 2013 from 30 trillion won in 2002 (33.6%).

Figure 9. Proportion of Funding Source in Credit Card Issuers

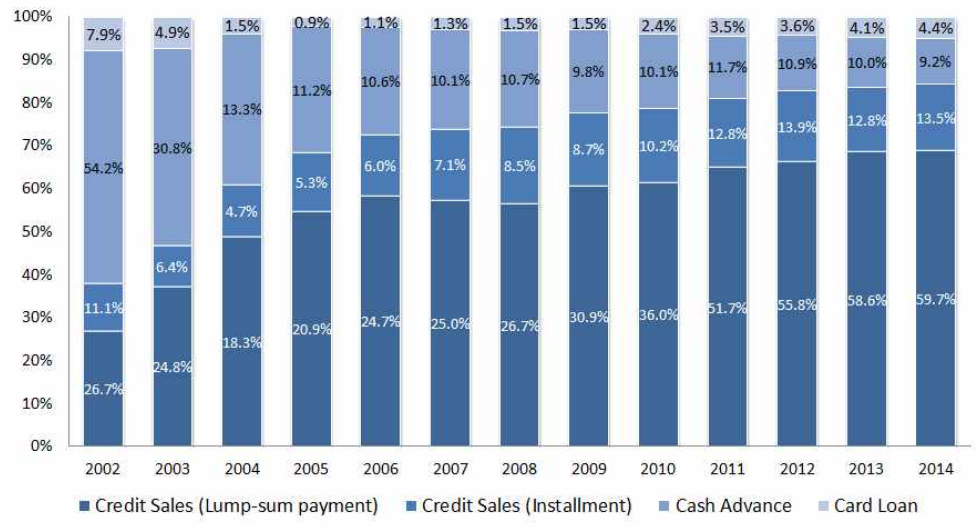


Note : FSA's Financial statistic system

As seen the trend of credit card usage methods such as credit sales(lump sum payment, installment purchase), cash advance, and card loan, the proportion of credit sales have constantly risen. One reason is that stores, receiving credit card, and small amount payments have increased. Total number of credit card payments was 8.0 billions in 2014 increased by 8%. Average amount per credit card payments has reduced from 61,350 won in 2013 to 58,535 won. Another reason is that demand of cash advance and card loan are decreased. Nowadays many alternative financing methods such as minus loan and small-loan finance of banks are appeared which replace credit card finance. Cash advance and card loan usage are 63 and 30 trillion won in 2013 respectively, but they were 371 and 54 trillion won in 2002. As

mentioned above, it is due to credit card issuers' unreasonable marketing and card lending during 2002~2003. Government intervened to stabilize this situation by stopping marketing and lending. After this intervention, card lending market have been reduced and stabilized.

Figure 10. Trend of Credit Card Usage Method



Note : FSA's Financial statistic system

3. Literature review

Ausubel (1991) insists basically credit card interest rate determined at the high level since credit card holders don't realize their high interest rate due to irrationality. They pay much higher interest rate than other financial services and are sensitive to annual fee rather than interest rate. Marketing of interest rate discount is also inefficient to credit card holders and they also have tendency of impulse buying. However, Zwicki (2000) insists that card holders are rational because credit card interest rates include many non-price factors and the

holders who are more concerned with convenience could be insensitive to interest rate. Ausubel (1991) also insists credit card market is non-competitive due to failure of competition among credit card issuers. Credit card issuers have excessive return for a long time and credit card interest rates are very sticky compared to cost of fund. He think high switching and searching cost induce credit card market non-competitive. There are high cost of information, paper work to do, and new annual fee to pay when finding lower interest rate. It is also possible to be rejected to join a new issuer and maximum limit of credit could be reduced. However, Zwicki (2000) insists that credit card interest rate have been decreased since 1990's and there is no excessive return because interest rate behaves like long-run stickiness. He also say that the cost of fund represents small part of credit card interest rate and entry cost of new companies is very low due to global card network companies (visa, mastercard etc.). Ex-ante risk-adjusted return also isn't large. Switching and searching cost aren't large because commercial advertising and disclosure have been done actively.

Meanwhile, Ausubel (1999) refers adverse selection problem on the other way. He think that high credit card interest rate is different from the bank loan. Stiglitz and Weiss (1981) say that interest rates of financial market are below the equilibrium level for preventing adverse selection with information asymmetric. However, Ausubel (1999) explains that credit card interest rate is above equilibrium level contrary to Stiglitz and Weiss (1981) because it starts high interest rate compared to bank. Credit card issuers could suggest lower interest rate to promote, but there would be adverse selection problem. Customers of low credit rating and high default probability could be only moved to search new issuers because they can pay high switching and searching cost. It means that they could pay for

searching cost to find lower interest rate rather than normal customers. Therefore, credit card issuers have tried to keep profitability by maintaining high level of interest rate.

There are also researches to do empirical analysis. Calem and Mester (1995) and Stango (2002) test the adverse selection problems using household's card debt balance under competitive market. They suggest that high switching and searching cost induce high interest rate. Brito and Hartley (1995) shows that there could be downward stickiness of credit card interest rate under card holder's rationality. They insist that we could avoid opportunity cost of holding cash since credit card provides short term liquidity. Also, it will increase possibility of adverse selection if interest rate is lowered, so companies keep interest rate high. Park (1997, 2004) shows that customers who expect own default probability increases borrow the money from credit card issuers. This averse selection problem would limit interest rate competition in the credit card market and explain abnormal return of credit card issuers. Stavins (2000) refers that there is little incentive to lower interest rate because credit card delinquent rate is high, but default rate is less than it. Cargill and Wendel (1996) say that credit card holders are rational even though they pay high interest rate. Because it is convenient to use credit card to lend and most of card balance don't have liability. Demuth (1986) also assumes card holder's rationality and say that a gap between card interest rate and cost of fund is explained by risk of default. The reasons of card lending are to stabilize the consumption and play the role of alternative method of lending. Morgan and Toll (1997) insists that credit card market be low entry barrier and competitive. Ayadi (1997) analyzes long-term relationship between card interest rate and cost of fund. They adjust the gap by changing interest rate 15% per quarterly and this is related to adverse selection and information asymmetry. Ponzdena (1991)

applies option pricing theory and shows high interest rate of credit card under unsecured debt and moral hazard even though we don't assume customer's irrationality. Akin et al. (2009) say that there are non-price competitions in credit card interest rate and credit card issuers have a certain monopolistic strength. Valadkhani et al. (2013) analyzes the movement of card interest rate is asymmetric to base interest rate of australia, so they expect a tight-money policy is effective rather than expansion policy.

In Korea papers, Kim (2002) analyzes the stickiness of interest rate between card management interest rate (cash advance and installment purchase) and market interest rate (corporate, call, conglomerate bond). As a result, relationships between card interest rate and cost of fund aren't statistically significant. Also, They verify adverse selection of credit card market using a ratio of delinquent borrower per generations. Song (2005) proofs how adverse selection occurs through theoretical model. Park and Ko (2001) chooses the adverse selection and moral hazard as the cause of hight interest rate and analyzes it with Korea credit card market data. As a result, there aren't adverse selection and moral hazard. They only find downward stickiness of credit card interest rate by investigating the movement between cash advance and cost of fund. When examining the determinant of credit card interest rate, a main factor of interest rates is cost of fund (Ausubel (1991), Kim (2002), Park and Ko (2010), Akin et al. (2009), Valadkhani et al. (2013)). This is basically same as bank loan interest rate move together with cost of fund such as base rae in same direction. There are risk factors, delinquency and default rate, to affect high interest rate in credit card market (Stavins (2000), Akin et al. (2009), Ayadi (1997)). Variables related to switching and searching cost are card account balance, annual fee, promotion cost, etc. (Calem and Mester (1995), Stango (2002), Joes and Wilson (2013), Park and

Ko (2010)). There are also non-price factors such as management cost of credit card issuers, asset, labor cost, market share, the number of branches (Canner and Luckett (1992), Stango (2002), Ayadi (1997), Akin et al. (2009)). In Korea, there is interest cap which foreign countries don't exist, so it's need to include regression (Scholnick (2000)). In U.S., a court allows credit card issuers to apply a interest cap, same as headquarter's state, in different states according to lawsuit of Marquette national Bank and First of Omaha Service Corp in 1979. This judgement disarms the credit card interest cap.

In this paper, we focus on macroeconomic factors which are key variables to know the default probability of households. However, pervious papers haven't considered to use macroeconomic variables when analyzing the determinants of credit card interest rate. Macroeconomic variables could affect interest rate directly through household default channel or credit card issuers could measure the probability of default indirectly. There are macroeconomic variables, household debt ratio, GDP, unemployment rate, as measuring the household's default probability. First of all, it is obvious for household debt ratio to affect default probability and there are several papers (Sullivan et al. (2000), Repetto (1998), Agarwal and Liu (2003)). Unemployment rate is also deeply related to household default (Hendershott and Schultz (1993), Repetto (1998), Deng et al.(2000), Livshits et al. (2001), Agarwal et al. (2002)). GDP could be mirror of unemployment rate. Jappelli et al. (2008) say that GDP and Debt to GDP affect households' arrears according to the Households' Indebtedness and Financial Fragility. GDP is one of key factor representing household default risk as measurement of economic situation.

4. Model

4.1. Theoretical Model

Stango (2002) made credit card interest rate model using Chen(1997)'s switching cost model. We set up the model adding household default probability (λ) to Stango (2002). There are A and B two credit card issuers and they set p_A and p_B which are credit card interest rate. α and c mean market shares and cost of fund respectively. m_A and m_B are additional discount interest rates of A and B to attract new customers. θ is switching cost when customers change their credit card issuer and it is assumed that switching cost are distributed interval between $[0, \theta]$. Chen(1997) set competitive market for two periods. First is 'new market' and second is 'mature market'. However, We focus on second market similar to Stango(2002) because Korea card market is close to mature stage. We adds customers' default probability (λ) to Stango (2002) and then analyzes how credit card interest rate affected by default probability (λ).

π^1 represents a profit when a card holder isn't in default ($1-\lambda$) on the loan and π^2 is a profit when a card holder is in default (λ). Expected profit $E(\pi)$ (equation 29, 32) can be calculated by adding a non-default part (equation 27, 30) and default part (equation 28, 31). There are two companies' profit structures below.

Followings represent profit structures of credit card issuers, A and B .

$$\pi_A^1 = \alpha(p_A - c)\left(1 - \frac{p_A - p_B + m_B}{\theta}\right) + \frac{1-\alpha}{\theta}(p_A - c - m_A)(p_B - p_A + m_A) \quad (27)$$

$$\pi_A^2 = \alpha(-c)\left(1 - \frac{p_A - p_B + m_B}{\theta}\right) + \frac{1-\alpha}{\theta}(-c - m_A)(p_B - p_A + m_A) \quad (28)$$

$$E(\pi_A) = (1-\lambda)\pi_A^1 + \lambda\pi_A^2 \quad (29)$$

$$\pi_B^1 = (1-\alpha)(p_B - c)\left(1 - \frac{p_B - p_A + m_A}{\theta}\right) + \frac{\alpha}{\theta}(p_B - c - m_B)(p_A - p_B + m_B) \quad (30)$$

$$\pi_B^2 = (1-\alpha)(-c)\left(1 - \frac{p_B - p_A - m_A}{\theta}\right) + \frac{\alpha}{\theta}(-c - m_B)(p_A - p_B + m_B) \quad (31)$$

$$E(\pi_B) = (1-\lambda)\pi_B^1 + \lambda\pi_B^2 \quad (32)$$

Followings are results of first-order derivative. Determinant variables are p_A, p_B, m_A, m_B and exogenous variables are $c, \lambda, \alpha, \theta$ which are given.

$$\begin{aligned}\frac{\partial E(\pi_A)}{\partial p_A} &= (1-\lambda)\alpha\left[\left(1 - \frac{p_A - p_B + m_B}{\theta}\right) - \frac{1}{\theta}(p_A - c)\right] \\ &\quad + (1-\lambda)\left(\frac{1-\alpha}{\theta}\right)[(p_B - p_A + m_A) - (p_A - c - m_A)] \\ &\quad + \lambda\alpha c\left(\frac{1}{\theta}\right) + \lambda\left(\frac{1-\alpha}{\theta}\right)(c + m_A) = 0,\end{aligned} \quad (33)$$

$$\begin{aligned}\frac{\partial E(\pi_A)}{\partial m_A} &= (1-\lambda)\left(\frac{1-\alpha}{\theta}\right)[(p_A - c - m_A) - (p_B - p_A + m_A)] \\ &\quad + \lambda\left(\frac{1-\alpha}{\theta}\right)[(-c - m_A) - (p_B - p_A + m_A)] = 0,\end{aligned} \quad (34)$$

$$\begin{aligned}\frac{\partial E(\pi_B)}{\partial p_B} &= (1-\lambda)(1-\alpha)\left[\left(1 - \frac{p_B - p_A + m_A}{\theta}\right) - \frac{1}{\theta}(p_B - c)\right] \\ &\quad + (1-\lambda)\left(\frac{\alpha}{\theta}\right)[(p_A - p_B + m_B) - (p_B - c - m_B)] \\ &\quad + \lambda(1-\alpha)c\left(\frac{1}{\theta}\right) + \lambda\left(\frac{\alpha}{\theta}\right)(c + m_B) = 0,\end{aligned} \quad (35)$$

$$\begin{aligned}\frac{\partial E(\pi_B)}{\partial m_B} &= (1-\lambda)\left(\frac{\alpha}{\theta}\right)[(p_B - c - m_B) - (p_A - p_B + m_B)] \\ &\quad + \lambda\left(\frac{\alpha}{\theta}\right)[(-c - m_B) - (p_A - p_B + m_B)] = 0,\end{aligned} \quad (36)$$

Above four equations are unique pure strategy Nash equilibrium. They induce equilibrium price (equation 38) and discount interest rate (equation 37).

$$m_A^* = m_B^* = \frac{(\lambda - 1)}{2\lambda - 3}\theta \tag{37}$$

$$p_A^* = p_B^* = \frac{\lambda - 2}{2\lambda - 3}\theta + \frac{c}{1 - \lambda} \tag{38}$$

By differentiating equilibrium price (interest rate) by default probability (λ) (equation 13), we could know that card interest rate and default probability move in the same direction. For example, Increasement of customers' default risk induces higher credit card interest rate.

$$p_A^{*\prime} = p_B^{*\prime} = \frac{1}{(2\lambda - 3)^2}\theta + \frac{c}{(1 - \lambda)^2} > 0 \tag{39}$$

4.2. Econometirc Model

Determinants of credit card interest rate are composed of default probability (λ), switching cost (θ), and cost of fund (c) by equation 38. Proxies of default probability in macroeconomic variables are household debt ratio, GDP, unemployment rate as we mentioned above. Proxies of switching cost are credit card debt account balances which are cash advance and card loan balance divided by amount of lump-sum purchase with credit card used in Stange (2002) model. Costs of fund (c) could be separated by card bond return and delinquency rate. Assets and credit sales (lump-sum payment) of card issuers could be also included in the regression model for considering unobserved cost and profitability even though we do panel regressions

with fixed effect. In case of card business operated by bank, it is difficult to separate assets between bank and card business. Therefore, it is reasonable to use credit sales (lump-sum payment) which is be directly proportional to amount of sales. In this field, papers use simple regression model, OLS (ordinary least square), to analyze determinants of card interest rate (Ausubel (1991), Park and Ko (2010), Stavins (2000)). There are also panel regression with random and fixed effect using household and firm level data (Akin et al. (2009), Stango (2002), Calem and Mester (1995)). Dependent variables are credit card interest rate (cash advance and card loan) and explanatory variables are return rate of card bond, credit sales (lump-sum payment), cash advance and card loan balance ratio (cash and loan balance/lump-sum purchase). These variables are panel data, but we use also time-series data such as interest cap by Usury act and macroeconomic variables (household debt ratio, GDP, unemployment rate).

In Equation (38), credit card interest rates (i^{cash}, i^{loan}) are dependent variables and credit sales (lncard), card bond return rate (cost3, cost12), switching cost (cashr, loanr), delinquency rate (delin), interest cap (cap), macroeconomic variables (macro; hdebt, GDP, unemp) are explanatory variables. Funding cost of cash advance uses 3 month maturity bond because average period of cash advance loan is 1~2 months. Funding cost of card loan uses 12 month maturity bond because average period of card loan is 3~36 months. There could be endogenicity variables such as credit sales (lump-sum payment), cash advance and card loan balance, delinquency rate. These variables could be affected by card interest rate, so lagged variables are used to avoid this problem. Other variables use same period with dependent variables. Equation (40) use random and fixed effect panel regression.

Panel Regression Model

$$i_{j,t} = \alpha_j + \beta_1 lncard_{j,t-1} + \beta_{2.1}\text{cost}_{j,t} + \beta_{2.2}\text{cost}_{j,t-1} + \beta_3 cashr_{j,t-1}(loanr_{j,t-1}) + \beta_{4.1} cap_t + \beta_{4.2} cap_{t-1} + \beta_5 delin_{t-1} + \beta_6 macro_{t,t-1,t-2} + e_{j,t} \quad (40)$$

where

$cost$: 3 *month maturity*, 12 *month maturity of card bond*
$delin$: *delinquncy over* 1 *month*
cap : *interest rate cap*
$macro$: *household debt ratio*, *GDP*, *unemployment*

5. Empirical Analysis

5.1. Data

This paper uses quarterly data from 2008:1Q~2014:4Q. credit card interest rate is disclosed in Credit Finance Association (CREFIA) of Korea. Interest rates of cash advance and card loan are annualized ratios of commission revenue which are calculated by dividing numerator which is amount of interest and commission revenues by denominator which is loan amount multiplied by usage days on a case by case basis (commission revenues / loan amount). There is interest cap regulated by government in Korea. Maximum interest rates of cash advance and card loan are set by Usury act. Cost of fund (cooperate bond) data uses the average of three big Credit Bureau (Korea Rating, Korea Investment Service, NICE rating) provided by Yonhap Informax. Funding cost of cash advance and card loan uses return rate of card bond in 3 and 12 month maturity respectively. Data of credit sales (lump-sum purchase), usage rate of cash advance and card loan are from Financial Statistics Information System (FISIS) of the Financial Supervisory Service (FSS) in Korea. Delinquency rate

represents overdue rate of credit card over 1 month which provided by FISIS. Macroeconomic variables, affecting household default risk, are household debt ratio (household debt/disposable income), seasonal adjusted real GDP and unemployment rate provided by Korea Bank.

Table 18. Data Categories and Sources

Category		Source
Interest rate	Cash advance	Credit Finance Association
	Card loan	
Government Policy	Interest cap	Usury Act[1)]
Card Usage	Credit Sale(Lump-sum purchase)	Financial Supervisory Service
	Cash advance	
	Card loan	
Cost of fund	Rate of card bond return	Yonhap Informax
Delinquency rate	Card delinquency rate over 1 month	Financial Supervisory Service
Macroeconomic variables (Default risk)	Household debt ratio (household debt/disposable income)	Korea Bank
	Seasonal adjusted real GDP growth rate	Korea Bank
	Seasonal adjusted unemployment rate	Korea Bank

Note : 1) Called "Act on registration of credit business, etc. and protection of finance users" in Korea

This paper analyzes how macroeconomic variables affect the credit card interest rate by using total 20 card issuers, operated by bank and specialized in card in this paper. There are 12 card issuers operated by bank and 8 card issuers specialized in card in 4Q 2014. Specialized card issuers are operated independently and separated by cooperate and bank basis issuers. Bank basis issuers stem from Bank. Several card issuers have experienced M&A and been separated from banks. Kookmin and Woori card was separated from Kookmin Bank in Mar 2011 and Woori Bank in Apr 2013 respectively. Korea Exchange Card

was separated from Korea Exchange Bank in Sep 2014 and Merged by HanaSk Card in Dec 2014. HanaSk Card Changes their name as Hana Card in Dec 2014.

Table 19. Credit Card Issuers' Status (4Q 2014)

Category		Issuers
Card issuers operated by Bank (12)		NH Bank, Gyeongnam Bank, Kwangju Bank, the Small and Medium Industry Bank, Daegu Bank, Busan Bank, National Federation of Fisheries Coooperative, Standard Chartered Bank, Citi Bank, Korea Exchange Bank, JB Bank, Jeju Bank
Specialized card issuers (8)	Bank basis (5)	Woori Card, BC Card, Shinhan Card, Hana Card, KB Kookmin Card
	Cooperate (3)	Lotte Card, Samsung Card, Hyundai Capital

5.2. Summary Statistics

Data of cash advance and card loan interest rate exists from 1Q 2002 to 4Q 2014, but it is unbalanced panel data. Other data, associated with card issuers, exists only from 1Q 2008 to 4Q 2014. Therefore, the period of regressions could be only 7 years. Interest rate of cash advance and card loan are 23.6% and 15.2% on average. Gap between cash advance and card loan is about 8.4%p because card loan has longer maturity. They have very low volatilities when compared to average card interest rate. Their standard deviations of cash advance and card loan are 2.61% and 3.34% respectively. Maximum interest rates of cash advance and card loan among card issuers are 29.55% and 23.24%. Minimum interest rates of them are 16.51% and 7.41%. Costs of fund (Card bond return rates) in 3 month and 12 month maturities are each 3.14% and 3.58% on average. Standard deviations of them are 1.73% and 1.75% respectively. Costs

of fund are more volatile than card interest rates, because their standard deviation is half of average. Interest cap is 42.11% on average. Minimum and maximum interest cap are 34.9% and 49.0% due to Usury act.

Amount of credit sales (lump-sum payment) is 4.41 trillion won on average per quarter and standard deviation of it is 4.99 trillion won. Maximum credit sales records 21.79 trillion won and minimum credit sales records 30 billion won. Cash advance usage ratio (cash advance / lump-sum payment) is 18.94% on average. Minimum and maximum cash advance ratios are 0.96% and 84.01% respectively. Card loan usage ratio is 4.24% on average and it is close to standard deviation 4.32%. Minimum card loan ratio is 29.02% since 2008. Delinquency rate over 1 month of credit card is 2.02% on average and standard deviation is 0.69%. Delinquency rate is getting reduced recently. Minimum and maximum of delinquency rate among companies are 1.39% and 3.44%.

Household debt ratio is 125.71% on average and standard deviation is 6.19. Minimum and maximum of Household debt ratio are 112.99% and 138.44%. It has been increased due to low base rate and the housing problem. Real GDP growth rate is 0.73% per quarter on average and a standard deviation is 0.94% which is above the average. Minimum and maximum of real GDP growth rate are -3.3% and 2.8%. Seasonal adjust unemployment rate is 3.4% on average and standard deviation is 0.29% which is less volatile. Minimum and maximum of unemployment rate are 3.0% and 4.2% respectively.

Table 20. Summary Statistics of Credit Card

Variables	N	Mean	STD	Min	Max
Cash advance (%)	582	23.58	2.61	16.51	29.55
Card loan (%)	504	15.22	3.34	7.41	23.24
Card bond return rate (3 month, %)	588	3.14	1.03	1.73	6.68
Card bond return rate (12 month, %)	585	3.58	1.26	1.74	7.83
Interest cap (%)	625	42.11	4.94	34.90	49.00
Credit sales (Lump-sum payment, trillion won)	553	4.41	4.99	0.03	21.79
Cash advance usage ratio(%) (Cash advance/Lump-sum payment)	553	18.94	11.44	0.96	84.01
Card loan usage ratio(%) (Card loan/Lump-sum payment)	525	4.24	4.32	0.00	29.02
delinquency rate (%)	700	2.02	0.69	1.39	3.44
Household debt ratio (%)	700	125.71	6.19	112.99	138.04
GDP growth rate(%)	725	0.73	0.94	-3.30	2.80
Unemployment rate(%)	725	3.40	0.29	3.00	4.20

A correlation of cash advance and card loan is 0.34 with 1% significant level. Cost of bond and card interest rate are significantly moved together with same direction. Correlations are between 0.24 and 0.58. A correlation of Interest cap and cash advance is 0.7 higher than card loan 0.3. Card interest rate and cash advance usage ratio is insignificant, but other usage ratios and interest rates are significant. Household debt ratio and interest rate are significantly moved with negative direction which we don't expect. Real GDP growth rate and interest rate are insignificant. Unemployment rate and cash advance interest rate is significantly moved with positive direction, but card loan interest rate is insignificant.

Table 21. Coefficients of Pearson Correlation

Variables	Cash Advance	Card Loan	Credit Sales	Card Bond (3m)	Card Bond (12m)
Card loan (%)	0.34***	1.00			
Credit sales	-0.19***	0.30***	1.00		
Card bond return rate (3m)	0.42***	0.24***	-0.06	1.00	
Card bond return rate (12m)	0.58***	0.34***	-0.08*	0.94***	1.00
Interest cap	0.70***	0.30***	-0.12**	0.46***	0.70***
Cash advance usage ratio	0.38***	0.38***	0.25***	0.33***	0.43***
Card loan usage ratio	0.01	0.56***	0.57***	0.08*	0.07
delinquency rate (%)	0.64***	0.30***	-0.11**	0.63***	0.77***
Household debt ratio (%)	-0.67***	-0.31***	0.14***	-0.53***	-0.70***
GDP growth rate(%)	-0.07*	-0.06	0.00	-0.24***	-0.23***
Unemployment rate(%)	0.09**	0.03	-0.03	-0.41***	-0.22***

Note : ***, **, and * denote the 1%, 5%, and 10% significance levels, respectively.

5.3. Results

5.3.1 Unit root test

Cash advance and card loan are unbalanced panel data, so we uses unit root test with Fisher-type and Im-Pesaran-Shin methods. Fisher-type's null hypothesis is that all panels contain unit root and alternative hypothesis is that at least one panel is stationary. We could judge to reject by test statistic value whether there is unit root. Im-Pesaran-Shin's null hypothesis is all panels contain unit root and alternative hypothesis is some panels are stationary. Im-Pesaran-Shin uses W-t-bar as a statistic value and Fisher-type model uses inverse normal as a static value.

As results of unit root tests, cash advance and card loan interest rates don't have unit root. Return rate of card bond also don't have unit root. log credit sales (lump-sum payment) and cash advance usage ration couldn't reject unit root in Fisher-type test, but reject it

in Im-Pearan-Shin test. GDP growth rate and time-series variables such as Delinquency rate, Household debt ratio, Unemployment rate don't have unit roots according to ADF (Augmented Dickey-Fuller) and PP (Phillips-Perron) tests. Therefore, we can use these variables to panel regression without solving the unit root problems.

Table 22. Unit Root Test

This table has the results of panel and time-series variable unit root test. Fisher-type model uses inverse normal as statistic value and Im-Pesaran-Shin uses W-t-bar as statistic value. ***, **, and * denote the 1%, 5%, and 10% significance levels, respectively.

Panel Variables	Fisher-type	Im-Pesaran-Shin
Cash advance (%)	-3.5877***	-3.4979***
Card loan (%)	-6.9398***	-4.4910***
Ln credit sales (lump-sum payment)	0.7788	-1.1504***
Card bond return rate (3 month, %)	-3.9312***	-3.9035***
Card bond return rate (12 month, %)	-5.8446***	-5.4274***
Cash advance usage ratio	-0.9683	-2.5044***
Card loan usage ratio	-5.6283***	-4.2130***
Time-series Variables	**Augmented Dickey-Fuller**	**Phillips-Perron**
Delinquency rate (%)	-5.246***	-2.085*
Household debt ratio (%)	-3.729**	-5.299***
GDP growth rate (%)	-4.431***	-5.660***
Unemployment rate (%)	-2.406**	-3.040**

5.3.2 Empirical Results

This paper do random and fixed effect panel regressions, but there is no significant differences of coefficients between them. Hausman test couldn't reject null hypothesis that coefficients are different. It means that unobserved characteristics of card issuers are not significant difference and are randomly distributed. I also did panel autocorrelation tests ($\rho = 0$) suggested by Bhargava et al.(1982) and Baltagi (1999). According to results, the models we estimates have autocorrelation. Therefore, this paper uses panel autocorrelation

regression methods. Explanatory variables, log credit sales (lump-sum purchase, lncard), cash advance usage ratio (cashr), and delinquency rate (delin), use lagged variables because they could have endogeneity problem as we mentioned above. Others are exogeneous variables. Macroeconomic variables and interest cap (cap) could affect credit card interest rate, but it is difficult to think credit card interest rates affect these variables.

As results of table (23), we couldn't find consistent relationship between cost of fund (card bond return rate of 3 month maturity). They have negative relationship in same quarter, but cash advance moves positive direction with lagged cost of fund. It means that cash advance interest rate increases approximately 0.2%p as cost of fund decreases 1%p in same quarter when GDP growth rate is only included in regression. However, cash advance interest rate increases approximately 0.17%p as cost of fund increases 1%p in previous quarter when unemployment rate is only included in regression. interest cap have positive coefficient with respect to cash advance interest rate at the 1% significance level. Cash advance interest rate increases approximately 0.08%p as interest cap increases. Delinquency rate have positive coefficients with respect to cash advance interest rate at the 5% significance level. Cash advance interest rate increases 1%p as delinquency rate increases 1%p in previous quarter.

This paper uses three macroeconomic variables such as household debt ratio (hdebt), GDP, and unemployment rate (unemp). Household debt ratio and unemployment rate have positive coefficient with respect to cash advance interest rate at the 5% significance level. Cash advance interest rate increases approximately 0.045%p as household debt ratio increases 1%p in previous quater. Cash advance interest rate increases approximately 0.5% as unemployment rate increases 1%p. However, GDP don't have significant coefficient at the 5% level.

Table 23. Determinants of Cash Advance Interest Rate

This table reports coefficients and significance of unbalanced panel regression. Explanatory variables are credit sales (lncard), cost of fund (cost3), interest cap (cap), cash advance usage raito (cashr), delinquency rate (delin), household debt rate (hdebt), GDP, unemployment rate (unemp). Data period is from 1Q 2008 to 4Q 2014. Standard errors is in parentheses. ***, **, and * denote the 1%, 5%, and 10% significance levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Cash Advance Interest Rate					
L.lncard	-0.205	0.343	-0.194	0.759**	-0.198	0.546*
	(0.127)	(0.347)	(0.127)	(0.318)	(0.127)	(0.313)
cost3	-0.100	-0.0694	-0.214**	-0.177*	-0.0497	-0.0221
	(0.0803)	(0.0827)	(0.106)	(0.105)	(0.0814)	(0.0793)
L.cost3	0.0190	0.0241	0.198	0.235	0.159*	0.174**
	(0.0800)	(0.0800)	(0.155)	(0.146)	(0.0830)	(0.0778)
cap	0.00705	0.00894	-0.0237	-0.0379	-0.0373	-0.0402
	(0.0352)	(0.0326)	(0.0347)	(0.0334)	(0.0341)	(0.0322)
L.cap	0.0819**	0.0771**	0.0783**	0.0645*	0.0934***	0.0914***
	(0.0353)	(0.0334)	(0.0350)	(0.0336)	(0.0331)	(0.0317)
L.cashr	-0.00442	0.0120	-0.00403	0.0257**	-0.00141	0.0224*
	(0.00760)	(0.0131)	(0.00755)	(0.0121)	(0.00762)	(0.0119)
L.delin	0.731***	0.790***	0.732**	1.127***	1.077***	1.167***
	(0.230)	(0.243)	(0.299)	(0.341)	(0.316)	(0.306)
hdebt	0.0137	0.0185				
	(0.0183)	(0.0171)				
L.hdebt	0.0446**	0.0473**				
	(0.0198)	(0.0184)				
L2.hdebt	0.0108	0.0159				
	(0.0172)	(0.0153)				
gdp			0.0910	0.116		
			(0.0777)	(0.0736)		
L.gdp			0.0302	0.0843		
			(0.0582)	(0.0581)		
L2.gdp			0.0403	0.0810*		
			(0.0470)	(0.0478)		
unemp					0.493**	0.534**
					(0.207)	(0.213)
L.unemp					0.404	0.502*
					(0.258)	(0.257)
L2.unemp					0.398	0.489**
					(0.246)	(0.231)
Constant	19.45***	10.68***	27.58***	14.63***	20.21***	8.274***
	(6.634)	(1.424)	(3.843)	(1.283)	(4.944)	(1.441)
Observations	437	416	437	416	437	416
R-squared	0.541	0.360	0.538	0.202	0.544	0.263
# of Issuers	21	21	21	21	21	21
Issuers RE	YES		YES		YES	
Issuers FE		YES		YES		YES

As results of table (24), Cost of fund (card bond 12 month) isn't significant with respect to card loan interest rate, but it has positive coefficients with unemployment rate at the 1% significance level. Card loan interest rate increases approximately 0.3%p as cost of fund increases 1%p in previous quarter with only unemployment rate variable. Delinquency rate of card has also positive coefficients with respect to card loan at the 5% significance level. Card loan interest rate increases approximately 0.9%p as delinquency rate increases 1%p. However, interest cap isn't significant with respect to card loan because average of card loan interest rate (15.22%) is much lower than interest cap (42.11%). Household debt ratio has positive coefficient at the 1% significance level. Card loan interest rate increases approximately 0.05%p as Household debt ratio increases 1%p in two-quarter lagged with fixed effect. GDP has positive coefficient at the 5% significance level. Card loan interest rate increases approximately -0.2%p as GDP increases 1%p in two-quarter lagged. Unemployment rate has positive coefficient at the 5% significance level with fixed effect. Card loan interest rate increases approximately 0.76%p as unemployment rate increases 1%p in previous quarter.

Table 24. Determinants of Card Loan Interest Rate

This table reports coefficients and significance of unbalanced panel regression. Explanatory variables are credit sales (lncard), cost of fund (cost12), interest cap (cap), card loan usage raito (loanr), delinquency rate (delin), household debt rate (hdebt), GDP, unemployment rate (unemp). Data period is from 1Q 2008 to 4Q 2014. Standard errors is in parentheses. ***, **, and * denote the 1%, 5%, and 10% significance levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Card Loan Interest Rate					
L.lncard	0.339	0.0457	0.342	0.121	0.383*	0.199
	(0.222)	(0.369)	(0.218)	(0.355)	(0.221)	(0.361)
cost12	0.0731	0.163	0.0483	0.0924	-0.0222	0.0262
	(0.105)	(0.109)	(0.119)	(0.124)	(0.109)	(0.110)
L.cost12	0.183*	0.204*	0.254	0.240	0.271***	0.278***
	(0.107)	(0.106)	(0.175)	(0.177)	(0.105)	(0.104)
cap	-0.00218	-0.00704	0.0166	0.0254	-0.00667	-0.000861
	(0.0502)	(0.0464)	(0.0485)	(0.0481)	(0.0490)	(0.0485)
L.cap	0.0530	0.0648	0.0309	0.0394	0.00183	0.0105
	(0.0490)	(0.0485)	(0.0476)	(0.0488)	(0.0465)	(0.0470)
L.loanr	0.0214	0.00375	0.0250	0.00358	0.0213	0.00563
	(0.0305)	(0.0434)	(0.0306)	(0.0426)	(0.0306)	(0.0426)
L.delin	0.521	0.896**	0.00179	0.293	0.853**	1.059**
	(0.338)	(0.377)	(0.421)	(0.533)	(0.432)	(0.441)
hdebt	-0.0145	-0.0159				
	(0.0258)	(0.0239)				
L.hdebt	0.0115	0.0198				
	(0.0285)	(0.0243)				
L2.hdebt	0.0377	0.0478**				
	(0.0238)	(0.0209)				
gdp			-0.0444	-0.0565		
			(0.0968)	(0.0981)		
L.gdp			-0.134	-0.115		
			(0.0844)	(0.0885)		
L2.gdp			-0.213***	-0.175**		
			(0.0673)	(0.0757)		
unemp					0.139	0.0616
					(0.286)	(0.309)
L.unemp					0.763**	0.630*
					(0.343)	(0.370)
L2.unemp					-0.0712	-0.0466
					(0.334)	(0.334)
Constant	3.136	5.751***	9.337*	10.91***	4.953	7.681***
	(9.359)	(1.596)	(5.539)	(1.376)	(6.574)	(1.550)
Observations	390	369	390	369	390	369
R-squared	0.194	0.104	0.203	0.128	0.198	0.144
# of Issuers	21	21	21	21	21	21
Issuers RE	YES	YES	YES	YES	YES	YES
Issuers FE		YES		YES		YES

Lastly, this paper do panel regressions including all macroeconomic variables, Table (25). Cost of fund has positive coefficients with respect to cash advance interest rate at the 5% significance level. Cash advance interest rate increases approximately 0.44%p as cost of fund increases 1%p in previous quater. Interest cap has significant coefficients with respect to cash advance, but not card loan. This result is same as previous results (Table 23, 24). Delinquency rate has positive coefficient with respect to cash advance interest rate at the 1% significance level. Cash advance interest rate increases approximately 1.66%p as delinquency rate increases 1%p.

Household debt ratio has positive coefficient with respect to cash advance and card loan at the 5% significance level. Card interest rates increase approximately 0.8%p~0.12%p as household debt ratio increases 1%p in previous quarter. Other lagged household debt ratio also have significant coefficients with respect to cash advance. GDP has negative coefficient with respect to card loan at the 5% significance level. Card loan interest rate decreases approximately -0.2%p as GDP increases 1%p. Unemployment rate has positive coefficients with respect to cash advance and card loan at the 5% significance level. Card interest rate increase approximately 1.05%p~1.18%p as unemployment rate increases 1%p in previous quater. Unemployment rate in two-quarters lagged has positive coefficient with respect to cash advance at the 1% significance level.

Table 25. Determinants of Interest Rate with Macroeconomic Factors

This table reports coefficients and significance of unbalanced panel regression. Explanatory variables are credit sales (lncard), cost of fund (cost3, cost12), interest cap (cap), cash advance and card loan usage ratios (cashr, loanr), delinquency rate (delin), household debt rate (hdebt), GDP, unemployment rate (unemp). Data period is from 1Q 2008 to 4Q 2014.Standard errors is in parentheses. ***, **, and * denote the 1%, 5%, and 10% significance levels, respectively.

	(1)	(2)	(3)	(4)
Variables	Cash Advance		Card Loan	
L.lncard	-0.204	-0.477	0.369*	-0.104
	(0.128)	(0.406)	(0.218)	(0.387)
cost3, cost12	-0.0214	-0.0554	0.0451	0.0450
	(0.127)	(0.121)	(0.153)	(0.152)
L.cost3, L.cost12	0.504***	0.369**	0.392*	0.346*
	(0.187)	(0.170)	(0.209)	(0.205)
cap	-0.0165	-0.0183	0.00177	-0.00375
	(0.0360)	(0.0386)	(0.0512)	(0.0532)
L.cap	0.166***	0.135***	0.0396	0.0391
	(0.0433)	(0.0388)	(0.0555)	(0.0531)
L.cashr, L.loanr	-0.00193	-0.0115	0.0327	-0.00779
	(0.00760)	(0.0143)	(0.0306)	(0.0437)
L.delin	1.771***	1.422***	1.032*	1.020
	(0.395)	(0.417)	(0.564)	(0.649)
hdebt	0.0545**	0.0519**	-0.0141	-0.0208
	(0.0218)	(0.0235)	(0.0296)	(0.0309)
L.hdebt	0.120***	0.0980***	0.0862**	0.0799**
	(0.0305)	(0.0253)	(0.0422)	(0.0329)
L2.hdebt	0.0840***	0.0498**	0.0309	0.0237
	(0.0270)	(0.0234)	(0.0371)	(0.0331)
GDP	0.251**	0.160	0.0447	0.0159
	(0.107)	(0.107)	(0.137)	(0.140)
L.GDP	0.0304	-0.0251	-0.0356	-0.0299
	(0.0705)	(0.0997)	(0.108)	(0.142)
L2.GDP	-0.0470	-0.0550	-0.213***	-0.195**
	(0.0520)	(0.0636)	(0.0699)	(0.0877)
unemp	0.181	0.441	-0.357	-0.357
	(0.280)	(0.396)	(0.437)	(0.570)
L.unemp	1.051***	1.147***	1.182***	1.102**
	(0.321)	(0.437)	(0.411)	(0.522)
L2.unemp	1.496***	1.223***	0.656	0.584
	(0.384)	(0.310)	(0.470)	(0.388)
Constant	-22.43*	-8.343***	-12.37	-1.793
	(11.52)	(1.842)	(14.31)	(1.900)
Observations	437	416	390	369
R-squared	0.557	0.524	0.223	0.0629
# of Issuers	21	21	21	21
Issuers RE	YES	YES	YES	YES
Issuers FE		YES		YES

6. Conclusion

This paper takes into account macroeconomic variables which haven't been included in previous works, determinants of credit card interest rate. Previously, Stango (2002) made a credit card interest rate model using Chen (1997)'s switching cost model. We set up the model to add household default probability to Stango (2002)'s model and uses macroeconomics variables as proxies for household default probability. Proxy variables could be household debt ratio, GDP, and unemployment rate. Other variables, determinant of the interest rate in this paper, are cost of fund (Ausubel (1991), Kim (2002), Park and Ko (2010), Akin et al. (2009), Valadkhani et al. (2013)), delinquency rate (Stavins (2000), Akin et al. (2009), Ayadi (1997), Park and Ko (2010)), and interest cap (Scholnick (2000)). Stango (2002)'s switching cost could use cash advance (cash advance usage / credit sales (lump-sum payment)) and card loan usage ratio (card loan usage / credit sales (lump-sum payment)). Lastly, we use log credit sales (lump-sum payment) because of considering unobservable characteristics of credit card issuers.

Firstly, cost of funds affects cash advance interest rate significantly according to results of Table (25). Cash advance interest rate increase approximately 0.44%p as cost of fund increases 1%p in previous quarter, and vice versa. Interest cap affects cash advance interest rate significantly, but not card loan. This is because average of card loan interest rate (15.22%) is much lower than interest cap (42.11%). Cash advance interest rate decrease 0.08p~0.17%p as interest cap decreases 1%p in previous quarter. Delinquency rate have positive coefficient with respect to cash advance at the 1% significance level. Cash advance interest rate increases 0.7%p~1.8%p as delinquency rate

increases 1%p in previous quarter, and vice versa, but card loan interest rate partly increases 0.9%p as delinquency rate increases 1%p in previous quarter.

Macroeconomics variables are used as proxies for household default probability. Household debt ratio have positive coefficient with respect to cash advance and card loan at the 5% significance level. Cash advance interest rate increases 0.05%p~0.12%p as household debt ratio increases 1%p depending on models. Card loan interest rate increases approximately 0.083%p as household debt ratio increases 1%p in previous quarter. GDP have negative coefficient with respect to card loan at the 5% significance level. Card loan interest rate increases approximately 0.2%p as GDP increases 1%p in two-quarter lagged. GDP affects card loan interest rate late compared to other macroeconomic variables. Unemployment rate have positive coefficient with respect to cash advance and card loan at the 5% significance level. Cash advance and card loan interest rate increases approximately 1.1%p as unemployment rate increases 1%p in previous quarter.

To sum up, both of cash advance and card loan interest rate increases as cost of fund increases even though there are little differences of coefficient size depending on models. Interest cap affects significantly to cash advance interest rate, but not card loan. Switching cost and interest rate don't have a significant relationship, but a regression model has little impact only in Table 23(4). Delinquency rate affects significantly to interest rate. Proxies of household default probability, Household debt ratio, GDP, and unemployment rate, have significant impacts on interest rate. Credit card interest rates increase as household debt ratio and unemployment rate increase, but decrease as GDP increases. Therefore, we can say that credit card interest rates are affected by macroeconomic variables significantly.

Appendix Ⅲ

Figure 11. Credit Card Interest Rate by Bank Associated

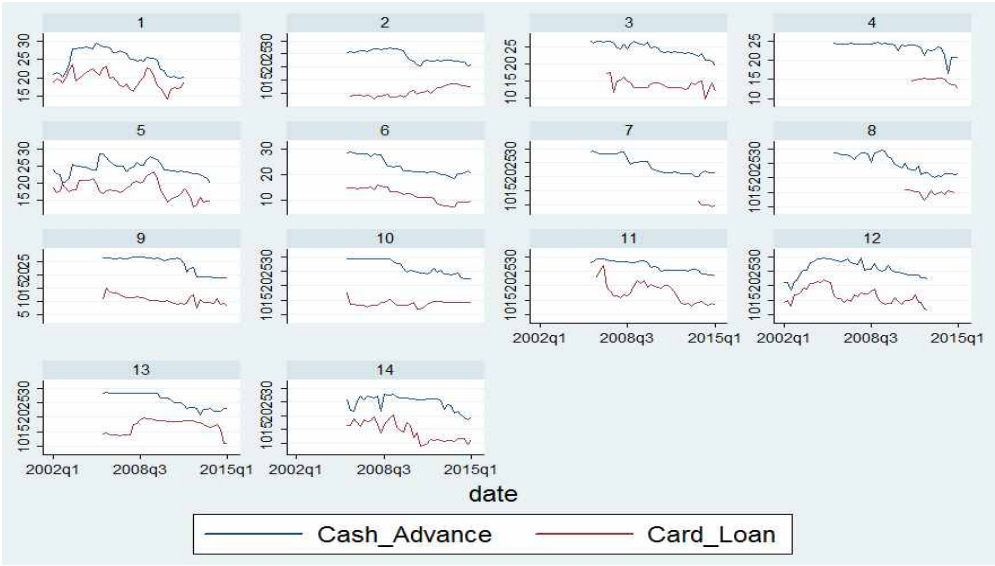


Figure 12. Credit Card Interest Rate by Specialized Issuers

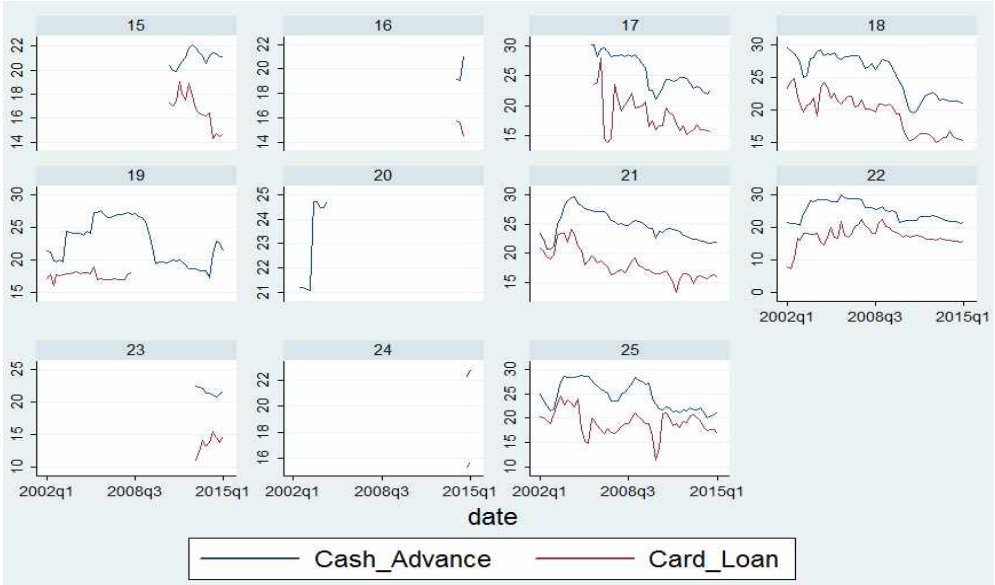


Table 26. History of Interest Cap Changes in Korea

This table use a term of Usury Act for simplicity which is called "Act on registration of credit business, etc. and protection of finance users" in Korea.

Period (enforcement date)	Interest Cap		Law	etc
1962.1.15.~965.9.23.	20%		Interest Limitation Act (ILA)	Enact of ILA
1965.9.24.~1972.8.2.	35.5%		Interest Limitation Act	
1972.8.3.~1980.1.11.	25%		Interest Limitation Act	
1980.1.12.~1983.12.15.	40%		Interest Limitation Act	
1983.12.16.~1997.12.11.	25%		Interest Limitation Act	
1997.12.12.~1998.1.12.	40%		Interest Limitation Act	
1998.1.13.~2002.10.26.	unlimited		-	abolition
2002.10.27.~2007.6.29.	Registered Usury	Unregistered Usury & P2P	Usury Act	Enact of Usury Act
	66%	66%[1)]		
2007.6.30.~2007.10.3.	66%	30%	Usury Act(left) Interest Limitation Act(right)	Enact of New ILA
2007.10.4.~2009.4.21.	49%	30%	Usury Act(left) Interest Limitation Act(right)	
2009.4.22.~2010.7.20.	Usury (Credit Finance Company)	P2P	Usury Act(left) Interest Limitation Act(right)	Revision
	49%	30%		
2010.7.21.~2011.6.26.	44%	30%	Usury Act(left) Interest Limitation Act(right)	
2011.6.27.~2014.4.1.	39%	30%	Usury Act(left) Interest Limitation Act(right)	
2014.4.2.~2014.7.14.	34.9%	30%	Usury Act(left) Interest Limitation Act(right)	
2014.7.15.~	34.9%	25%	Usury Act(left) Interest Limitation Act(right)	

References I

Carrieri, F., Errunza, V., Hogan, K., 2007. "Characterizing world market integration through time", Journal of financial and Quantitative Analysis, Vol. 42, No. 4, pp. 915-940.

De Jong, F., De Roon, F. A., 2005. "Time-varying market integration and expected returns in emerging markets", Journal of Financial Economics, Vol. 78, No. 3, pp. 583-613.

Driessen, J., Laeven, L., 2007. "International Portfolio Diversification Benefits: Cross-Country Evidence from a Local Perspective", Journal of Banking and Finance, Vol. 31, No. 6, pp. 1693-1712.

Eun, C. S., Huang, W., Lai, S., 2008. "International Diversification with Large- and Small-Cap Stocks", Journal of financial and Quantitative Analysis, Vol. 43, No. 2, pp. 489-524.

Goetzmann, W. N., Li, L., Rouwenhorst, K. G., 2005. "Long-Term Global Market Correlations", Journal of Business, Vol. 78, No. 1, pp. 1-38.

Grubel, H. G., 1968. "Internationally Diversified Portfolios: Welfare Gains and Capital Flows", American Economic Review, Vol. 58, No. 5, pp. 1299-1314.

Huberman, G., Kandel, S., 1987. "Mean-Variance Spanning", Journal of Finance, Vol. 42, No. 4, pp. 873-888.

Lee, S., Lee, S., Yoon, J., 2011, "International Diversification with Small-cap Stocks: Mean-Variance Spanning Tests", Academy of Accounting and Fianncial Studies Journal, Vol 15, SI, No. 2, pp. 55-60.

Lessard, D. R., 1973. "International Portfolio Diversification: A Multivariate Analysis for a Group of Latin American Countries", Journal of Finance, Vol. 28, No. 3, pp. 619 - 633.

Lessard, D. R, 1976. "World, Country, and Industry Relationships in Equity Returns: Implications for Risk Reduction Through International Diversification", Financial Analysts Journal, Vol. 32, No. 1, pp. 32-38.

Levy, H., Sarnat, M., 1970. "International Diversification of Investment Portfolios", American Economic Review, Vol. 60, No. 4, pp. 668-675.

Longin, F., Solnik, B., 1995. "Is the Correlation in International Equity Returns Constant: 1960-1990?", Journal of International Money and Finance, Vol. 14, No. 1, pp. 3-26.

Markowitz, H. M., 1959. "Portfolio Selection: Efficient Diversification of Investments", John Wiley & Sons, New York.

Pukthuanthong, K., Roll, R., 2009. "Global market integration: An alternative measure and its application", Journal of Financial Economics, Vol. 94, No. 2, pp. 214-232.

Solnik, B., 1974. "Why Not Diversify Internationally Rather Than Domestically", Financial Analysts Journal, Vol. 30, No. 4, pp. 48-54.

Solnik, B., Noetzlin, B., 1982. "Optimal international asset allocation", Journal of Portfolio Management, Vol. 9, No. 1, pp. 11-21.

References Ⅱ

Berry, S., 1994. “Estimating discrete-choice models of product differentiation,” The RAND Journal of Economics, Vol. 25, No. 2, pp. 242-262.

Berry, S., Levinsohn, J., Pakes, A., 1995. “Automobile prices in market equilibrium”, Econometrica; Journal of the Econometric Society, Vol. 63, No. 4, pp. 841-890.

Berry, S., Pakes. A., 2007. “The pure characteristics demand model,” International Economic Review, Vol. 48, No. 4, pp. 1193-1225.

Brenkers, R., Verboven, F., 2006. “Liberalizing a distribution system: the European car market,” Journal of the European Economic Association, Vol. 4, No. 1, pp. 216-251.

Brynjolfsson, E., Hu, Y., Smith, M. D., 2003. “Consumer surplus in the digital economy: Estimating the value of increased product variety at online booksellers,” Management Science, Vol. 49, No. 11, pp. 1580-1596.

Byers, J., Mitzenmacher, M., Zervas, G., 2012. “The groupon effect on yelp ratings: A root cause analysis.” arXiv:1202.2369.

Catry, B., Chevalier, M., 1974. “Market share strategy and the product life cycle.” The Journal of Marketing, pp. 29-34.

Chen, Y. M., 1997, “Paying Customers to Switch.”, Journal of Economics & Management Strategy, Vol. 6, No. 4, pp. 877-897.

Davenport, T. H., Beck, C. J., 2001. “The attention economy: Understanding the new currency of business.” Harvard Business Press.

Dholakia, U. M., 2011. “How businesses fare with daily deals: A multi-site analysis of groupon, livingsocial, opentable, travelzoo, and buywithme promotions,” SSRN: http://ssrn.com/abstract=1863466.

Dube, J., 2004. “Multiple discreteness and product differentiation: demand for carbonated soft drinks,” Marketing Science, Vol. 23, No. 1, pp. 66-81.

Edelman, B., Jaffe, S., Kominers, S. D., 2011. “To groupon or not to groupon: The profitability of deep discounts,” Harvard Business School, Working Paper 11-063.

Fan, Y., 2013. “Ownership consolidation and product characteristics: A study

of the US daily newspaper market," The American Economic Review, Vol. 103, No. 5, pp. 1598-1628.

Ghose, A., Smith, M. D., Telang, R., 2006. "Internet exchanges for used books: An empirical analysis of product cannibalization and welfare impact," Information Systems Research, Vol. 17, No. 1, pp. 3-19.

Ghose, A., Han, S. 2011. "An Empirical Analysis of User Content Generation and Usage Behavior on the Mobile Internet," Management Science, Vol. 57, No. 9, pp. 1671-1691.

Ghose, A., Han, S., 2014. "Estimating Demand for Mobile Applications in the New Economy," Management Science, Vol. 60, No. 6, pp. 1470-1488.

Ghose, A., Ipeirotis, P., Li, B., 2012. "Designing ranking systems for hotels on travel search engines by mining user-generated and crowd-sourced content," Marketing Science, Vol. 31, No. 3, pp. 493-520.

Goolsbee, A., Petrin, A., 2004., "The consumer gains from direct broadcast satellites and the competition with cable TV," Econometrica, Vol. 72, No. 2, pp. 351-381.

Grigolon, L., Verboven, F., 2011., "Nested logit or random coefficients logit? A comparison of alternative discrete choice models of product differentiation", Review of Economics and Statistics, Vol. 96, No. 5, pp. 916-935.

Kumar, V., Rajan, B., 2012. "Social coupons as a marketing strategy: a multifaceted perspective," Journal of the Academy of Marketing Science, Vol. 40, No. 1, pp. 120-136.

Li, X., 2013. "How Does Online Reputation Affect Social Media Endorsements and Product Sales?" Evidence from Regression Discontinuity Design," WISE.

Li, X., Wu, L., 2012. "Measuring Effects of Observational Learning and Social-Network Word-of-Mouth(WOM) on the Sale of Daily-Deal Vouchers," WISE.

Marketwatch., 2014. Annual Financials for Groupon Inc. http://www.marketwatch.com/ investing/ stock/grpn/ financials

Masatlioglu, Y., Nakajima, D., Erkut Y. O., 2012. "Revealed attention," The American Economic Review, Vol. 102, No. 5, pp. 2183-2205.

McFadden, D., 1974, “Conditional Logit Analysis of Qualitative choice behavior”.

McFadden, D., 1976, “Quantal Choice Analysis: A Survey”, Annals of Economic and Social Measurement, 5/4.

Nevo, A. 2001., “Measuring market power in the ready-to-eat cereal industry,” Econometrica, Vol. 69, No. 2, pp. 307-342.

Pesendorfer, M. 2002., “Retail sales: A study of pricing behavior in supermarkets,” The Journal of Business, Vol. 75, No. 1, pp.33-66.

Song, M., 2007. “Measuring consumer welfare in the CPU market: An application of the pure characteristics demand model,” Rand Journal of Economics, Vol. 38, No. 2, pp. 429-446.

Song, M., 2011. “A hybrid discrete choice model of differentiated product demand with an application to personal computers,” University of Rochester.

Subramanian, U., 2012. “A theory of social coupons,” University of Texas at Dallas, Working Paper.

Varian, H. R., 1980. “A model of sales,” The American Economic Review, Vol. 70, No. 4, pp. 651-659.

Wu, J., Shi, M. Hu, M., 2013. “Threshold effects in online group buying,” Rotman School of Management, Working Paper.

Ye, M., Wang, C., Aperjis, B. Huberman, A, Sandholm, T. 2011. Collective Attention and the Dynamics of Group Deals,” Pennsylvania State University Working Paper.

References Ⅲ

Agarwal S., Liu C., 2003, “Determinants of Credit Card Delinquency and Bankruptcy: Macroeconomic Factors”, Journal of Economics and Finance, Vol. 27, No. 1.

Akin G. G., Aysan A. F., Kara G. I., Yidiran L., 2009, “Non-Price Competition in Credit Card Markets through Bank Level Benefits, Economic Research Forum 16th Annual Conference.

Athreya K., Sanchez J. M, Tam X. S, Young E. R., 2012, “Bankruptcy and Delinquency in a Model of Unsecured Debt”, Federal Reserve Bank of Richmond

Ausubel L. M., 1999, “Adverse selection in the credit card market”, University of Maryland Working Paper.

Ausubel, L. M., 1991, “The failure of competition in the credit card market”, American Economic Review, 81, pp. 50-81.

Ausubel, L. M., 1999, “Adverse selection in the credit card market“, working paper.

Ayadi O. F., 1997, “Adverse Selection, Search Costs and Sticky Credit Card Rates”, Financial Services Review, Vol. 6, No. 1, pp. 53-67.

Baltagi, B., Wu. P. X., 1999, “Unequally spaced panel data regression with AR(1) disturbances,” Econometric Theory, Vol. 15, pp. 814-823.

Bernake B., 1990, “On the Predictive Power of Interest Rates and Interest Rate Spreads”, NBER Working Paper Series.

Bhargava, A., Franzini, L., Narendranathan, W., 1982, “Serial correlation and the fixed effects model,” Review of Economic Studies, Vol. 49, pp. 533-549.

Brady R. R., 2005, “Credit Cards and Monetary Policy: Are Households still Liquidity-Constrained?”, WEAI Conference.

Brito D. L., Hartley P. R., 1995, “Consumer Rationality and Credit Cards”, The Journal of Political Economy, Vol. 103, No. 2.

Calem, P. S., Mester, L. J., 1995, “Consumer Behavior and the Stickiness of Credit-Card Interest Rates”, American Economic Review, Vol. 85, No. 5, pp. 1327-1336.

Canner G. B., Luckett C. A., 1992, “Developments in the Pricing of Credit Card

Services", Federal Reserve Bank of St. Louis.

Cargill T. F., Jeanne W., 1996, "Bank Credit Cards: Consumer irrationality versus Market Forces", The Journal of Consumer Affair, Vol. 30, No. 2.

Chen, Y. M., 1997, "Paying Customers to Switch.", Journal of Economics & Management Strategy, Vol. 6, No. 4, pp. 877-897.

Cornett M. M., Musumeci J., 2014, "How legislation Affects Value: The Failure of Credit Card Cap Legislation", Financial Management, Vol 20, No. 3, pp. 83-94

Cottarelli, C., Ferri, G., Generale, A.,1995, "Bank lending rates and financial structure in Italy: A case study", IMF Working Papers, No. 38.

DeMuth, C.C., 1986, "The Case Against Credit Card Interest Rate Regulation," Yale Journal on regulation Vol. 3, pp. 201-42.

De Bondt, G.J., 2002, "Retail bank interest rate pass-through: New evidence at the euro area level, European Central Bank Working paper series no.136.

Dotsey M., 1998, "The Predictive Content fo the interest Rate Term Spread for Future Economic Growth", Federal Reserve Bank of Richmond Economic Quarterly Vol. 84, No. 3, pp. 31-51.

Ehrmann, M., Gambacorta, L., Martinez Page's, J., Sevestre, P., Worms, A., 2003, "Financial systems and the role of banks in monetary policy transmission in the Euro area", Cambridge University Press, Cambridge.

Ekici T., Dunn, L., 2010, "Credit Card Debt and Consumption: Evidence from Household-Level Data, Applied Economics, Vol. 42, No. 4, pp. 455-462.

Engle, R., Granger, C., 1987, "Cointegration and Error Correction: Representation, Estimation and Testing. Econometrica Vol. 55, pp. 251-276.

Estrella A., Mishkin F., 1996, "The Yield Curve as a Predictor of U.S. Recessions", Current Issues in Economics and Finance, Vol 2, No. 7.

Evans R. W., 2012, "Determinants of Short-term Consumer lending Interest Rates"., BYU Macroeconomics and Computational laboratory Working Paper.

Financial Supervisory Service, 2014, Credit-specialized finance companies and mutual credit union interest rate rationalization propulsion system, 2014.09.26

Gambacorta, L., 2008, "How do banks set interest rates?"European Economic Review, Vol. 52, No. 5, pp. 793-819.

Goldberg L. G., 1975, “The Effect of State Banking Regulations on Bank Credit Card Use: Comment”, Journal of Money, Credit and Banking, Vol. 7, No. 1, pp. 105-112.

Gross D. B., Souleles N. S., 2002, “Do Liquidity Constraints and Interest Rates Matter For Consumer Behavior? Evidence From Credit Card Data”, NBER Working Paper No. 8314.

Ivanova D., Lahiri K., Seitz F., 2000, “ Interest rate spread as predictors of German inflation and business cycles”, International Journal of Forecasting Vol. 18, pp. 39-58.

Jappelli, T. J., Pagano, M., Maggio, M. D., 2008, “Households’ Indebtedness and Financial Fragility”, IMF 9th Jacques Polak Annual Research Conference November 13-14.

Jose, L. Z., Wilson, J. O. S., 2013, “Credit card interest rates and risk: new evidence from US survey data”, The European Journal of Finance, Vol. 20, No. 10, pp. 829-914.

Kashyap, A., Stein, J. C., 2000, “What do a million observations on banks say about the transmission of monetary policy”, Ameriacan Economic Review, Vol. 90, No. 3, pp. 407-428.

Kerr S., Dunn L., 2012, “Consumer Search Behavior in the Changing Credit Card Market”, Journal of Business & Economic Statistics, pp. 345-353.

Kim, S. H., Rho, H. S., 2014, “Determinants of bank interest rates : An Empirical Analysis of the bank transfer of market interest rates”, Korea Institute of Finance, KIF Working Paper 14-08

Kim, Y, K., 2002, “Research on the phenomenon and its cause of stiffening credit card interest rates”, Credit Finance Association Credit Card No.22.

Kinsey J., 1981, “Determinants of Credit Card Accounts: An application of Tobit Analysis“, Journal of Consumer research, Vol. 8, No. 2, pp. 172-182.

Lim, G. C., 2000, “Bank interest rate adjustments: Are they asymmetric?”, The Economic Record, Vol. 77, No. 237, pp. 135-147.

Meier S., Sprenger C., 2010, “Present-Biased Preferences and Crdeit Card Borrowing”, Applied Economics, Vol. 2, No. 1, pp. 193-210.

Mester L. J., 1994, “ Why are Credit Card Rates Sticky?” Economic Theory, Vol. 4, No. 4, pp. 505-530.

Mogan, D. P., Toll, I., 1997, “Bad Debt Rising”, FRB of New York Current Issues, Vol.3, No.4.

Park S., 1997, “Option value of Credit Lines as an explanation of high credit card rate”, Federal Reserve Bank of New York.

Park S., 2004, “Consumer Rationality and Credit Card Pricing: An Explanation Based on the Option Value of Credit Lines:, Managerial and Decision Economics, Vol. 25, No. 5, pp. 243-254.

Park, Y. S., Ko, H. J., 2010, “A study on the causes of high interest rates in the credit card market: centering on moral hazard and adverse selection”, Korean Management Review Vol. 39 No. 5, pp. 1277-1297

Prager R. A., Manuszak M. D., Kiser E. K., Borzekowski R., 2009, “Interchange Fees and Payment Card Networks: Economics, Industry Developments, and Policy Issues”, Federal Reserve Board of Washington D.C.

Pozdena, R.J., 1991. Solving the credit card mystery. Wall Street Journal (December 26), 17.

Scholnick B., 2000, “Regulation, Competition and Risk in the Market for Credit Cards”, Canadian public Policy/analyse de Politiques, Vol. 26, No. 2, pp. 171-181.

Shy O. and Wang Z., 2011, “Why Do Payment Card networks Charge Proportional Fees?”, The American Economics Review, Vol. 101, No. 4, pp. 1575-1590.

Smith W. L., 1957, “Consumer Instalment Credit”, The American Economic Review, Vol. 14, No. 6, pp. 966-984.

Song, S.Y., 2005, “Credit Card Interest Rate with Imperfect Information”, Korean journal of financial management Vol. 22 No. 2, pp. 213-226.

Stango V., Zinman J., 2009, “What Do Consumers Really Pay on Their Checking and Credit Card Accounts? Explicit, Implicit and Avoidable Costs”, The American Economic Review, Vol. 99, No. 2, pp. 424-429.

Stauffer R. F., 2004, “Credit Cards and Interest Rates: Theory and Institional Factors”, Journal of Post keynesian Economics, Vol. 26, No. 2, pp. 289-301.

Stavins J., 1996, “Can Demand Elasticities Explain Sticky Credit Card Rates?”, Federal Reserve Bank of Boston.

Stavins J., 2000, “Credit Card Borrowing, Delinquency, and Personal Bankruptcy”, Federal Reserve Bank of Boston.

Steindl F. G., 2000, “Credit Cards, Economization of Money, and Interest

Rates", The Journal of Economic Education, Vol. 31, No. 3, pp. 271-279.
Stiglitz J. E., Weiss A., 1981, "Credit Rationing in Markets with Imperfect Information", The American Economic Review, Vol. 71, No. 3, pp. 393-410.
Telyukova, 2009, "Household Need for Liquidity and the Credit Card Debt Puzzle", Review of Economic Studies, Vol. 80, pp. 1148-1177.
Valadkhani, A., Anwar, S., Arjomandi A., 2013, "Downward stickiness of interest rates in the Australian credit card market", Journal of the Asia Pacific Economy.
Weth, M.A., 2002, "The pass-through from market interest rates to bank lending rates in germany", Economic Research Center of the Deutsche Bundesbank, Disscussion Paper No. 11.
Zwicki, T. J., 2000, "The Economics of credit cards" Law and Economics Working Paper.
Rose, Sanford., 1990. The coming revolution in credit cards. American Banker, April 4, 4-15.
Sullivan, T., Warren, E., Westbrook, J., 2000. "The Fragile Middle Class: Americans in Debt", Yale University Press, New Haven and London.
Repetto, A., 1998. "Personal Bankruptcy and Individual Wealth Accumulation". Ph.D. Thesis, MIT.
Deng, Y., Quigley, J., Van Order. R., 2000. "Mortgage Termination, Heterogeneity and the Exercise of Mortgage Options." Econometrica Vol. 68, pp. 275-307.
Livshits, I., MacGee, J., Tertilt. M., 2001. "Consumer Bankruptcy: A Fresh Start. Working Paper #617, Research Department", Federal Reserve Bank of Minneapolis.
Agarwal, S., Chomsisengphet, S., Elul, R., 2002. "Personal Bankruptcy Exemptions and Mortgage Default." Mimeographed. Brown University.

초록

글로벌 분산투자, 구조적 수요추정, 신용카드 대출이자율에 관한 세 가지 연구

윤 종 문
서울대학교 대학원
경제학부 경제학 전공

본 논문은 총 3개의 주제로 구성되어 있다. 첫 번째는 소형주 해외펀드의 글로벌 분산투자 효과를 분석하는 것이다. 투자자산을 국가별 대형주에서 소형주 해외펀드로 확대하고 이에 대한 글로벌 분산투자의 실효성이 사라지고 있다는 것을 보였다. 이는 국제금융시장에서의 분산투자에 있어 소형주 해외펀드 보다 상관관계가 낮은 투자자산을 찾아야 된다는 시사점을 제공해 준다.

두 번째는 소셜커머스의 상품별 판매자료를 이용하여 구조적 방법론을 이용하여 수요함수를 추정하였다. 이는 기존의 수요추정에 발생할 수 있는 IIA (Independence of Irrelevant Alternatives)의 문제를 해결하고 개인별 판매 자료가 없이도 개인자료 수준의 회귀분석을 할 수 있는 분석방법론(BLP, Modified BLP, RCNL)을 이용한 것에 가치가 있다. 또한 소셜커머스에서의 판매기간이 판매에 부정적 영향을 미칠 수 있다는 것을 보였고 이를 Attention Economy와 Search Cost 문제로 해석하였다.

마지막 주제는 거시경제변수가 신용카드 대출이자율에 미치는 영향을 다룬다. 거시경제변수는 가계파산위험을 나타내는 대리변수로 사용 가능하다. 따라서 Stango(2012)의 전환비용 모델에 가계파산확률을 추가하여 신용카드 대출이자율 결정요인을 분석하였고, 신용카드 대출이자율이 거시경제변수의 움직임에 민감하게 반응한다는 것을 밝혀냈다. 다만, 조달금리, 금리상한, 연체율과 달리 전환비용은 유의하지 않았다.

……
주요어: 글로벌 분산투자, 구조적 수요함수, 수요추정, 신용카드, 대출이자율, BLP
학 번: 2011-30075