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How does the price structure of two-sided markets affect transaction volume and market share: evidence from the Korean credit card market

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Abstract

This study aims to empirically examine the impact of the price structure of two-sided markets on transaction volume and market share (MS) in the context of the Korean credit card industry. The Korean credit card market differs from those in the United States (U.S.) or Europe in terms of transaction structure (i.e. a three-party system in Korea vs a four-party system in the U.S. or Europe) and government policy. In addition to the merchant discount rate and the cardholder annual membership fee rate, the authors included and analyzed exogenous variables to eliminate any endogeneity. Based on the analysis results, the authors found that credit card usage performance (i.e. transaction volume) increases with an increase in the relative price ratio (merchant discount rate ÷ cardholder membership fee rate) paid by merchants and cardholders, provided that the total price (merchant discount rate + cardholder membership fee rate) paid by merchants and cardholders remains constant. Therefore, this study is the first to confirm that the Korean credit card market operated as the theoretical mechanism of a two-sided market during the analysis period. This effect can only be observed in specific cases such as the launch of the so-called "Chief Executive Officer(CEO)-designed card." When a new CEO takes office in a credit card company and launches a "CEO-designed card," there is a significant increase in not only card usage performance but MS as well owing to the price structure changes caused by expanding the benefits that customers derive from card use.

Keywords Credit card market, Two-sided markets, Merchant discount rate, Cardholder membership fee rate, Relative price ratio

Paper type Research paper

1. Introduction

In recent years, the Korean credit card market has witnessed dramatic growth. As of 2020, domestic card usage amounted to Korean Won (KRW) 877.3tn (credit card usage amounted to KRW 705.3tn, while check (or debit) card usage accounted for KRW 172.0tn), which represents 98.1% of Korea's total private consumption expenditure, i.e. KRW 894.1tn [1]. The total number of cards issued was 220m (110m credit cards, 110m debit cards), the number of credit cards per individual in an economically active population was about 4.1 cards, and the

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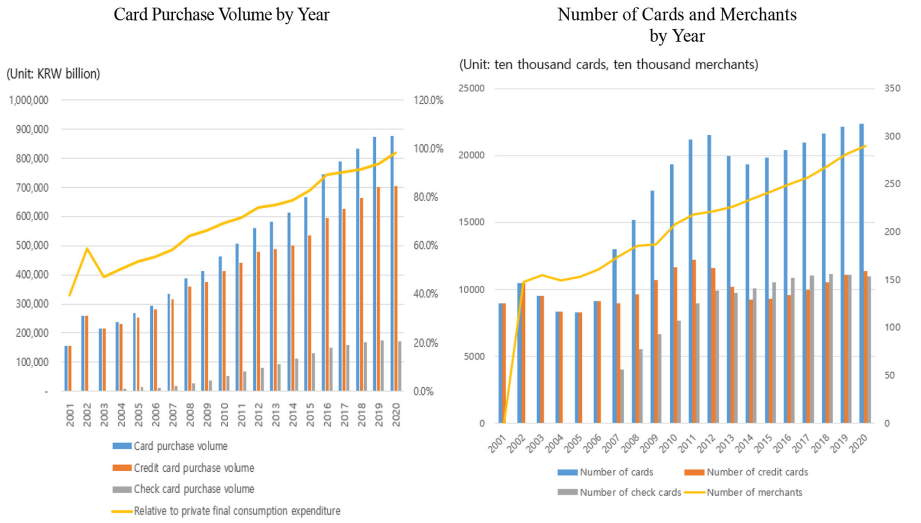


Note(s): This figure illustrates the growth of the Korean credit card market since 2001. The figure on the left compares the card (credit card and check (debit) card) transaction volume by year, while the figure on the right represents trends in the numbers of cards and merchants

Source(s): Statistical data of Korean Credit Finance Association

Figure 1.
Card purchase volume by year and number of cards and merchants by year

number of merchants that accepted cards was 2.9m (see Figure 1). The main reasons for this quantitative growth are government policies introduced to discover tax sources and stimulate the overall economy, the development of marketing and payment systems for credit card companies, and the introduction of regulations related to the domestic credit card market that meet the conditions of a two-sided market. These regulations include prohibiting credit card companies from rejecting card payments and a no-surcharge rule.

According to Rhee (2010), "a two-sided market is a market in which two different types of user groups can interact through a platform, and the value created on the platform is affected by indirect network externality." The usage fees in a two-sided market is adjusted by the platform on which the two user groups participate and not by direct interactions between the two user groups. Such markets are characterized by indirect or cross network externality, wherein the participation level of one user group changes due to adjustments in platform usage fees, which further affects the utility of the second user group. Network externality is a phenomenon wherein the value of a product or service is affected by the number of product/service users as in the case of telephones or messenger services.

Indirect network externality occurs when the utility of two user groups connected via a platform varies depending on the size and demand for each other's products/services. The newspaper advertisement market, marriage brokerage companies and the credit card market, where such indirect network externality exists, are representative of two-sided markets. In recent times, various portal sites have also been classified as typical two-sided market platforms.

According to the two-sided market theory, a credit card market is a market with indirect network externality, wherein the cardholders' utility increases when the number of merchants extending credit cards increases, and the merchants' utility increases when the number of cardholders increases. Based on this indirect network externality, the price structure of a two-sided market is one in which credit card companies charge discriminatory

prices to member stores (merchants), while cardholders increase their transaction volume, i.e. card usage, on the platform [2].

According to Rochet and Tirole (2003, 2006), when a buyer pays a price p^B and a seller pays a price p^S, then the total price (TPR) is given by $p = p^B + p^S$ (price level). A platform that sets the prices p^B and p^S, without changing p, indicates the presence of a price structure. They further explained that this price structure is the unique pricing system of a two-sided market that can affect a platform's transaction volume when the price level is given.

In the credit card market, the extent to which the benefit of merchants increases when the number of cardholders increases is greater than the extent to which the benefits of cardholders increase when the number of merchants increases. Moreover, due to the differences in the respective abilities of cardholders and merchants to negotiate with credit card companies, both domestically and overseas, in reality, merchants tend to pay relatively higher prices than cardholders [3]. However, due to this price structure, when card usage increases, merchant sales also increase, providing further incentive for merchants to accept cards [4]. However, since empirical studies on this topic are limited, the current study seeks to analyze the relationship between price structure and card transaction volume (CTV) using Korean data.

However, if a surcharge rule, such as requiring merchants to charge additional fees when cardholders use their respective cards, is implemented, merchants and cardholders can neutralize this discriminatory price structure set by credit card companies. In other words, the price structure of credit card companies cannot affect card usage. Therefore, the impossibility of additional fees is a prerequisite for a two-sided credit card market [5]. In Korea, such additional fees are prohibited by law [6]. Additionally, the National Tax Service has instructed businesses over a certain size to become credit card member stores in accordance with the Income Tax Act. This creates an institutional environment that is suitable for the characteristics of a two-sided credit card market.

In the United States (U.S.) and Europe, credit card markets have a transaction structure that involves a four-party system (card issuer, card acquirer, merchant, cardholder) [7]. As shown in Table 1, in a four-party system, both the card issuers and card acquirers charge various fees such as interchange fees, acquisition fees, network assessment fees, cardholder annual membership fees and account maintenance fees to the merchants and cardholders. Hence, it is

	Four-party scheme (USA, Europe, etc.)			Three-party scheme (Korea)	
Payer		Name	Payee	Name	Payee
Merchant	Merchant discount rate	Interchange fee - Card issuance, cardholder management, authorization of transactions, etc.	Issuer	Merchant discount	Credit card company
		Network assessment fee - building and management of a network	Card network company		
		Acquisition fee - recruitment and acquisition of merchants	Acquirer		
Cardholder	Annual membership fee		Issuer	Annual membership fee	Credit card company
	Account maintenance fee and other fees		Issuer	None	None

Note(s): This table compares the fee structure, payers and payees of two different transaction systems. The four-party scheme is more common in the U.S. and Europe, while the Korean credit card market is based on the three-party scheme

Table 1.
Comparison of transaction structures and fees in domestic and overseas credit card markets

difficult to determine the price level and structure in a four-party system. In contrast, the Korean credit card market has a three-party system (credit card company, merchant, and cardholder), and its price structure only comprises credit card companies' merchant discounts and annual membership fees. As mentioned above, this specificity of the Korean credit card market satisfies the theoretical conditions of a two-sided market and makes it easy to understand its price structure. Thus, the conditions of the Korean credit card market are appropriate for empirically analyzing the effects of the price structure of a two-sided market.

Meanwhile, domestic and foreign studies on credit card markets have demonstrated that an externality exists between the number of merchants and card issuances (i.e. cardholders). However, these studies did not empirically analyze the effect of this externality on the price structure of the credit card market [8]. In contrast, the current study empirically analyzes the effect of the credit card market's price structure, comprising merchant and cardholder fees, on card usage. This research is expected to contribute to expanding the understanding of the card market by confirming whether the two-sided market price theory, as suggested by Rochet and Tirole (2003, 2006), can be applied to the Korean credit market.

In consideration of the indirect network externality that exists in the credit card market, the institutional characteristics of the Korean credit card market (regulation that forces business operators to accept credit cards and prohibits them from charging additional fees for card use), the marketing competition among credit card companies and prior literature, previous studies have predicted and analyzed the impact of the differences in price structure between merchants and cardholders on CTV and market share (MS) [9].

As mentioned above, since the relative utility of the merchants participating in the credit card market is greater than that of cardholders, merchants are incentivized to pay relatively high prices compared with cardholders. Moreover, considering the market situation wherein credit card companies provide various benefits, such as interest-free installments, discounts and mileage, to promote credit card usage and merchant discount revenue is generated from the price structure, it is expected that the higher the relative price ratio (RPR) (merchant discount rate ÷ cardholder annual membership fee rate) of merchants, the higher the CTV [10]. Consequently, RPR was observed to have a significant positive effect on CTV.

Additionally, when a new CEO takes office in a credit card company, both card usage and MS tend to increase. This effect can be attributed to the "CEO-designed card," which is a card that is issued when a new CEO takes office. This new card is typically launched by a newly appointed CEO to increase the company's CTV and MS. These cards provide rewards, such as higher point accumulation and price discounts, which can effectively lower the cardholders' burden in using these cards. Moreover, the causal relationship between price structure and CTV is supported by the Granger causality and impulse response function (IRF) tests. In conclusion, it has been empirically proven that a price structure effect, as described by the two-sided market theory, exists in the Korean credit card market during the analysis period.

This remainder of this study is organized as follows. Chapter 2 discusses the domestic and international theoretical background as well as prior research on two-sided credit card markets and their price structure. Chapter 3 describes the data utilitzed in this study and presents an empirical analysis on the impact of the price structure of credit card markets on CTV and MS. Finally, Chapter 4 summarizes the research models and analysis results, while Chapter 5 presents the conclusions of this study.

2. Theoretical background and literature review

2.1 Theoretical background

The two-sided market theory has been studied since the early 2000s. Several theories have been proposed to explain the characteristics of business models that connect different user groups, such as software, media, payment systems and Internet companies, and the price

structure that maximizes profits or transaction volume. According to Kim *et al.* (2008), the reason for the increased research on two-sided markets was that, while the phenomenon of two-sided markets is not a new concept, many services, such as the internet and software services, that have increasingly gained importance in daily life due to technological development, possess the characteristics of a two-sided market.

Previous studies that presented theoretical frameworks for two-sided markets have highlighted the presence of multiple different user groups who need each other, indirect network externality and the non-neutrality of the price structure, as prerequisites for two-sided markets. A two-sided market is a market in which a company provides a platform that facilitates interactions between two different user groups. However, two-sided markets are not only characterized by their role as an intermediary between two customers only, but also their role as markets in which platform usage is affected not only by the price level imposed on two user groups but also the price structure (Rochet and Tirole, 2003, 2006).

Rochet and Tirole (2003, 2006) presented indirect network externality and the non-neutrality of price structure as preconditions for the effects of a two-sided market's price structure. An indirect network externality refers to a special type of externality wherein the utility obtained by one user group is affected by the size or consumption of another user group; hence, the relative size of an indirect network externality affects the marekt price structure. Since price structure determines the participation and transaction volume of two user groups, Lee (2011) stated that the most important step in setting usage fees in a two-sided market is to set a price structure that can generate profits while allowing both groups to participate on the platform. The non-neutrality of the two-sided market's price structure refers to when participants in both user groups cannot adjust the transaction price through direct negotiations due to problems such as asymmetric information, transaction costs and free-riding. Non-neutrality of the price structure is maintained when additional payments are prohibited between the two user groups. In the Korean credit card market, additional payments (side payments or surcharges) are prohibited by law; hence, the non-neutrality of the market's price structure is maintained.

The canonical price structure model of Rochet and Tirole (2003, 2006) is an important theoretical basis for the research model in the current study. They suggested that, when a buyer pays price p^B and a seller pays price p^S, then the TPRP, given by $p^B + p^S$ (i.e. $p = p^B + p^S$), on the platform on which p^B and p^S are paid, keeping p constant, is described as a price structure. Moreover, they defined price structure as the unique pricing system of two-sided markets that can affect a platform's transaction volume without changing the price level (p). Examining this model further, the presence of a monopoly platform with two user groups (buyers, B and sellers, S) on both sides of it ($i \in \{B, S\}$) can be assumed. On each side i, the average benefit per transaction is b^i and the usage fee per transaction is a^i. The net benefit per transaction is given by $b^i - a^i$, the fixed benefit offered to the end user is B^i, the membership fee is A^i, the fixed cost of the platform per member is C^i, the marginal cost per interaction is $\boldsymbol{c}$, and the number of members on the opposite side is N^j. Thus, the net utility of an agent on side i can be given by the following equation:

$$U^i = (b^i - a^i)N^j + B^i - A^i. \tag{1}$$

The platform's profit is given by the following equation:

$$\pi = \sum_{i=B,S} (A^i - C^i)N^i + (a^B + a^S - c)N^B N^S. \tag{2}$$

With $i \in \{B, S\}$, the per-interaction price (p^i) can be defined as $p^i \equiv a^i + \frac{A^i - C^i}{N^j}$, while the platform's price level (p) refers to the sum of the prices of the two groups, $p^B + p^S$. Since the

number of users that join the platform from the ith group (N^i) depends on p^i and N^j, the demand function of the ith group can be defined as follows:

$$N^i = \Pr(U^i \geq 0) = \Pr\left(b^i + \frac{B^i - C^i}{N^j} \geq p^i\right) \equiv D^i(p^i, N^j). \tag{3}$$

In the above equation, the demand function of each user group can be expressed as a function of the price structure (p^B, p^B) and is denoted as $N^i = n^i(p^B, p^S)$. Consequently, the profit function can be transformed as follows:

$$\pi = (p^B - p^S - c)n^B(p^B, p^S)n^S(p^B, p^S). \tag{4}$$

For a given and fixed TPR ($p = p^B + p^S$), the optimal price structure can be obtained by determining the prices paid by buyers and sellers to maximize the transaction volume function ($V = n^B(p^B, p^S)n^S(p^B, p^S)$) as follows:

$$\mathrm{V(p)} = \mathrm{MAX}\left[n^B(p^B, p^S)n^S(p^B, p^S)\right], \text{ under the constant } p\left(= p^B + p^S\right). \tag{5}$$

Price level can be determined using the standard Lerner formula, $\frac{p-c}{p} = \frac{1}{\eta}$. If η is the elasticity of volume with respect to the TPR, $\eta \equiv -p\frac{V'(p)}{V(p)}$, then the optimal price structure can be obtained using the below equation:

$$\frac{p}{p-c} = \eta \equiv -p\frac{V'(p)}{V(p)}, \Leftrightarrow -\frac{1}{p-c} = \frac{V'(p)}{V(p)}. \tag{6}$$

The optimal price structure is obtained when the derivatives obtained from differentiating transaction volume ($V = n^B(p^B, p^S)n^S(p^B, p^S)$) by price are equal. Therefore, we derived the following formula:

$$-\frac{1}{p-c} = \frac{V'(p)}{V(p)} = \frac{\frac{\Delta n^B}{\Delta p^B}}{n^B} + \frac{\frac{\Delta n^S}{\Delta p^B}}{n^S} = \frac{\frac{\Delta n^S}{\Delta p^S}}{n^S} + \frac{\frac{\Delta n^B}{\Delta p^S}}{n^B}. \tag{7}$$

Sonn *et al.* (2008) interpreted the above equation as the price structure wherein the ratio of the marginal contributions of price changes on both sides to the total transaction volume is the same [11].

When there are no fixed costs and benefits, price structure can be rewritten using the standard Lerner formula as follows:

$$\frac{p^i - (c - p^j)}{p^i} = \frac{1}{\eta^i}. \tag{8}$$

The implications of Rochet and Tirole's (2003, 2006) canonical price structure model is that the optimal price in a two-sided market does not depend on the marginal cost of each user group. According to this model, when there are two groups, B and S, on different sides of a platform, the net cost becomes $c - p^j$ by lowering the price p^j of the ith user group and raising the price p^j of the other user group. If the price elasticity of demand of the ith user group is high enough to lower the p^i, a price structure strategy to increase the p^j is theoretically possible. However, the question remains as to whether the other group can accept the increased p^j. Accordingly, the optimal price can be determined by when the change in the price elasticity of demand of the two user groups is the same.

Therefore, if one user group has a strong indirect network externality in relation to another user group, the platform can achieve platform efficiency without changing price

levels by lowering their own prices and raising the prices of other user groups. However, Rochet and Tirole's (2006) canonical price structure model assumes that a monopoly platform connects two user groups and that the transaction volume of two-sided markets is the value multiplied by the quantity demanded on both sides. Therefore, it is difficult to completely understand the Korean credit card market wherein several credit card companies compete using this model. In particular, in Korea, since merchants are obliged to accept credit cards, the price structure that maximizes credit card usage is not determined solely by the relative size of indirect network externality but by the relative demand for credit card platforms among merchants and members, as suggested by Rochet and Tirole's (2006) model.

Evans (2003) explained that there is a difference between the price discrimination that occurs in two-sided markets and one-sided markets [12]. In a one-sided market, price discrimination is viewed as a way to increase profits, while price discrimination in a two-sided market is an essential condition of business establishment. If one user group is charged a low price and another user group charges a high price, if the lower price offered to one user group is not attractive enough for that group to conduct a transaction, the business will not be established at all.

Additionally, Parker and Alstyne (2005) showed that the price for each user group in the relative pricing structure of a monopoly platform is determined by indirect network externality. In other words, if the utility of an indirect network externality that is generated when participating on a platform is large, then higher prices are borne. In contrast, if the utility of the indirect network externality is small, lower prices are borne.

Based on the two-sided market theory, developed by Rochet and Tirole (2003, 2006), Evans (2003), and Parker and Alstyne (2005), it is possible to understand the price structure of credit card markets wherein merchants pay relatively higher prices than cardholders. This price structure can be viewed as a reflection of the strong indirect network externality related to cardholders, i.e. the increase in sales that occurs when merchants participate in the credit card market. Consequently, these theories support the prediction offered by this study that the RPR, which represents price structure, affects card transactions volume when the price level is given.

2.2 Literature review

2.2.1 Studies in other countries. Relevant studies on two-sided credit card markets overseas can be divided into an empirical analysis of indirect network externalities, a study on price discrimination against a particular user group in a two-sided market and a study on the competitive structure of two-sided markets. Evans (2003) performed an empirical analysis of indirect network externalities by analyzing the effect of the number of merchants and cardholders on CTV. He found that the increase in the number of card transactions was quicker when the number of merchants increased and slightly slower when the number of cardholders increased [13]. Evans (2003) explained that, while these results do not precisely fit the Rochet-Tirole model, which states that the trading volume in a two-sided market increases in proportion to the demand on both sides of the market. It is reasonable to assume that the demand function in a two-sided market is a multiple of the demand of the user groups. Rysman (2007) confirmed that the CTV of a card network company is related to the degree of card acceptance by local merchants, i.e. the number of merchants in the card company's network and found that the number of merchants affects the card usage performance of cardholders (positive feedback loop) [14].

In their price discrimination study, Caillaud and Jullien (2003) stated that platforms that connect different user groups have the characteristic of using relevant divide-and-conquer pricing strategies wherein one user group supports the costs of another user group due to indirect network externality. Parker and Alstyne (2005) defined a special market wherein content is provided or traded between end users and demonstrated the existence of a market in which products are distributed at a discount or free-of-charge to one user group. In such a

market, groups that support and those that receive support are determined by the relative size of the indirect network externality. If the size of the indirect network externality is large and its contribution to demand is high, a product can be supplied at a relatively low price or free-of-charge. These previous studies on price discrimination in two-sided markets theoretically support the fact that merchants bear a relatively high price burden compared with cardholders in the credit card market. This higher price burden can be attributed to the effect of a two-sided market's price structure in terms of the increasing CTV.

In their study on the competitive structure of two-sided markets, Filistrucchi *et al.* (2014) divided the externalities in two-sided markets into membership and usage externalities. When only membership externalities exist, two-sided markets are classified as two-sided non-transactional markets, and when both membership and usage externalities exist, they are classified as two-sided transactional markets. Furthermore, Filistrucchi *et al.* (2014) stated that the credit card market should be viewed as a single two-sided transactional market wherein the transactions between merchants and cardholders occur simultaneously. Additionally, in 2018, the U.S. Supreme Court, in a judgment on whether the American Express Card's (AMEX card) merchant terms and conditions were anti-competitive, ruled that the credit card market should be viewed as a single market by considering both the merchants and cardholders [15]. The majority opinion of the ruling was that the mere fact that credit card companies charge a higher fee for merchants than other competitors is insufficient to judge the behavior of these companies as anti-competitive since it would mean that credit card companies incur more expenditure to offer benefits, such as customer rewards, to cardholders compared with their competitors. Kim and Kim (2020) explained that the U.S. Supreme Court's decision contradicts the Korean government's logic for lowering the merchant discount rate in 2018. At the time, the Korean government proposed the logic that credit card holders were receiving too many benefits compared with the annual membership fees charged to them; thus, reducing the number of unnecessary benefits could lower merchant discounts. Kim and Kim (2020) interpreted this logic as opposing the U.S. Supreme Court's ruling on AMEX cards, which states that increasing merchant discounts alone cannot be viewed as an anti-competitive issue.

2.2.2 Studies in Korea. The research on two-sided markets in Korea can be divided into overseas studies on the core content of the two-sided market theory, studies on the price structure of two-sided markets, and studies on the competitive characteristics of two-sided market operators.

Rhee (2010) compared and analyzed the definition of a two-sided market along with existing theories on the conditions required for a two-sided market. His results suggested that the indirect network externality between users and the impossibility of additional/side payments were important prerequisites for a two-sided market. Hwang (2009) stated that the core content of the two-sided market theory is that the quantity demanded by one user group depends on the quantity demanded by another user group. Therefore, when determining the price structure for user groups on both sides, it is necessary to comprehensively consider the change in demand on one side caused by the changes in price itself, the change in demand on one side caused by the change in demand on the other side, and the marginal cost incurred by each side. Sonn *et al.* (2008) stated that a multisided platform has competitive characteristics that differ from those of a single-sided market, and there exists an indirect network externality wherein the platform's utility changes according to the interactions between the two user groups. Therefore, they argued that market definition and market power analysis based on a simple market-share-and-margin analysis could lead to inappropriate conclusions.

In a study on two-sided credit card markets, Jang (2008) empirically analyzed the effect of the number of merchants and card issuances on CTV and found that the interaction variable multiplied by the number of merchants and the number of cards issued had a positive effect on CTV. Jang (2008) interpreted these results to mean that both merchants and users should increase, not just one group, to

create a positive effect on CTV. Furthermore, he stated that indirect network externality, a characteristic of two-sided markets, exists in Korea's credit card market.

Additionally, Yang *et al.* (2013) stated that, in a credit card market, indirect network externalities exist between merchants and card holders, and these externalities have the characteristics of two-sided markets that are internalized by the pricing of credit card companies. Therefore, he argued that high merchant discounts and low cardholder fees do not affect the welfare transfer from merchants to cardholders in that merchants can pass on merchant discounts to product prices, or cardholder benefits can be internalized through increased merchant sales. However, Yang *et al.* (2013) argued that, when surcharges are prohibited, a merchant cannot differentiate the price of the final goods by payment method (price coherence) and has no choice but to accept customers' cards even if the merchant must pay a fee that is higher than the additional benefits obtained from accepting the card. Thus, market failure may hinder the welfare of consumers.

Choi (2013) examined whether the basic premise of the two-sided market theory, i.e. the premise that merchants and cardholders must consider the size of opposing groups when signing up on a credit card platform can explain the already saturated nature of domestic credit card market. Based on his research, he suggested the possibility that, in a mature two-sided credit card market such as Korea, the reason why cardholders have cards issued to them is not the versatility of card use but the additional two-sided market benefits obtained from cards created through strategic alliances between credit card companies and certain large merchants. Accordingly, Choi (2013) presented a related research model. However, he could not perform empirical analysis due to the practical limitation of inaccessibility to credit card companies' data.

Previous research on the Korean credit card market from a two-sided market perspective has focused on theoretical models, laws and institutions rather than empirical analysis. The limitations of these previous studies can be attributed to the difficulties in securing the internal data of credit card companies to study the transaction structure of a two-sided credit card marketand finding a verified empirical analysis model based on the theoretical background. Therefore, resolving data acquisition limitations by synthesizing various data, the current study provides empirical evidence on the Korean credit card market and analyzes the effect of price structure on card usage performance, even when the credit card market differs in terms of transaction structures and system. These results could help to further understand the Korean credit card market and establish related policies.

3. Data and variables

3.1 Data

The data in this study comprises panel data of seven credit card companies in Korea for a period of 31 quarters, starting from the first quarter of 2011 to the third quarter of 2018. At the end of 2020, among a total of eight credit card companies, only the BC Card, which differs from other credit cards in the way its revenue structure is related to merchant discounts, was excluded from the analysis [16].

The current system for calculating the merchant discount rate, known as the qualifying cost system, was introduced by the Korean government in 2013 and the merchant discount rate of credit card companies has been adjusted by policy every three years [17]. To consider these differences by period in the analysis, we included the three years before the current qualifying cost system, the three years of the first qualifying cost period and three years of the second qualifying cost period as the analysis period. However, since we only included data that were prepared using the same statistical standard, except for the periods that could not be compared due to changes in accounting standards, we used 8, 12 and 11 quarters, respectively, (i.e. a total of 31 quarters) as the analysis period [18].

Meanwhile, for the KB Kookmin Card and the Woori Card, only the data after their spin-offs (the KB Kookmin Card was spun off from KB Kookmin Bank in March 2011 and the Woori Card was spun off from Woori Bank in April 2013) were included. Additionally, we only included data regarding the Hana Card after its merger with the Hana SK Card was completed (in December 2014) after being spun off from KEB. Therefore, the study data comprises unbalanced panel data. Additionally, we excluded quarterly data at the time of spin-offs of the KB Kookmin Card and the Woori Card since the data was only available for a part of the quarter (KB Kookmin Card in 2011 Q1, Woori Card in 2013 Q2), which would make comparison with other quarters inappropriate. Similarly, Hana Card data for the third and fourth quarters of 2014 were also excluded for comparability reasons (spun off from Korea Exchange Bank as KEB Card in September 2014 and merged with Hana SK Card in December 2014).

Finally, based on the data of seven credit card companies and 31 quarters, we obtained 190 observations out of a total of 217 quarterly data. For the credit card companies, we collected data, such as CTV, MS, cardholder annual membership fees, bad loans, total loans, expenses of credit card companies and check (or debit) CTV, from the Financial Statistical Information System of the Financial Supervisory Service. Economic data, such as customer price index, consumer composite sentiment index (CCSI), gross domestic product (GDP), were collected from the Economic Statistical System of the Bank of Korea and the Yonhap News Infomax.

3.2 Definition of variables

To examine the impact of the price structure of two-sided markets on transaction volume and MS, we selected the quarterly CTV and MS as dependent variables. As an explanatory variable, we selected the RPR, a proxy variable of a credit card company's price structure that indicates the relative burden (price allocation) between merchants and cardholders in card transactions. RPR refers to the value obtained by dividing the merchant discount rate by the cardholder annual membership fee rate. The merchant discount rate and the cardholder annual membership fee rate are standardized values obtained by dividing the credit card company's merchant discount revenue and annual membership fee revenue, respectively, by the CTV. Additionally, to proxy the price level, TPR was used as a control variable since the price level should not change when RPR changes. TPR is given by the sum of the merchant discount rate and the cardholder annual membership rate.

To prevent endogeneity issues caused by the omission of other variables that may affect transaction volume, the consumer price index (CPI), the CCSI, and the GDP change rate (ΔGDP) were used as additional control variables. Regarding the selection of exogenous variables, we followed previous studies, which showed that changes in final consumption expenditure have a positive effect on credit card usage (Seo, 2016) and domestic GDP growth rate also has a positive correlation with credit card use (Kim and Lee, 2020; Ham and Kim, 2013).

Additionally, as internal factors of credit card companies, the bad loan ratio (BADLR) and other card expenses (OE), which represent marketing expenses, were selected as additional control variables. Jang (2008) found that BADLR has a significant negative effect on CTV. This is because, when BADLR increases, credit card companies strengthen their risk management by implementing strategies such as reducing the credit card usage limit of cardholders. Regarding marketing expenses, in a previous study by Ham and Kim (2013), it was found that CTV significantly increased when the marketing expenses directed toward cardholders were increased. Control variables also include the prepaid card sales (PCS) to control the size of CTV, and check(debit) card usage ratio (CCR) to control the change in the merchant discount rate due to the changes in the CCR [19, 20].

In the actual analysis, we used the quarterly difference in the logarithm values of the variables, i.e. the quarterly change rate. Since the unit of the variables differ in terms of amount (trillion won), rate (%), multiples and index, we judged that it would be easy to interpret the regression coefficient by standardizing it using the rate of change from the previous quarter.

Additionally, we could secure the stability of the time series. However, to enhance the understanding of the Korean credit card market, the original level values of CTV, RPR and TPR are presented in the descriptive statistics. Furthermore, we included the merchant discount rate and cardholder annual membership fee rate, which together constitute the RPR of the credit card market, in the descriptive statistics. Table 2 describes in detail the definitions of the variables used in this study and how they were calculated.

4. Models and results

4.1 Analysis model

The analysis model in this study analyzes whether CTV is only affected by changes in the price structure, represented by the RPR, without changes in the price level (TPR) imposed on both merchants and cardholders. This research model applies the two-sided markets price structure model, proposed by Rochet and Tirole (2003, 2006), to the four-party system credit card market. In the model of Rochet and Tirole (2003, 2006), the two-sided markets price was based on the fee per transaction. Domestic merchant discount is a ratio per transaction amount and thus, it meets this requirement, but the cardholder annual membership fee is different because cardholders only pay a fixed annual fee.

However, in the domestic credit card market, the annual membership fee can be seen as a per-transaction fee. Since the domestic credit card market is mature, credit card companies encourage existing members to issue new cards with high additional rewards compared to the annual fee, thereby facilitating additional card usage by cardholders. It can be seen that the price to the cardholders per transaction amount is lowered. Moreover, in most cases, since the newly issued card is a credit card with a higher merchant discount rate than a debit card, the merchant discount rate may increase. Consequently, it is to adjust the price structure of the platform as defined by Rochet and Tirole (2003, 2006).

Since there is also no price structure in the real credit card market, wherein a fee is charged to members every time they use a card, the credit card market cannot be considered as a two-sided market under the assumption that the annual membership fee is only a fixed fee. Lee (2011) stated that card users are provided with various rewards from credit card companies based on their card use. If the annual membership fee is viewed only as a sunk cost, it is like arbitrarily excluding the balance in which consumers receive rewards rather than paying membership fees. Rochet and Tirole (2011) also change the view point about membership fee as a transaction cost instead of a sunk cost.

Rochet and Tirole (2003, 2006) showed that optimal pricing is achieved at the point where the change in demand due to price changes on both sides become identical. In other words, it is not recommended to unilaterally increase the burden on one group of users to obtain a price structure that maximizes platform activity. However, our research model predicts that CTV increases when merchants pay a relatively high price compared to cardholders, i.e. the RPR increases. This prediction is based on the consideration of the following factors: first, the competitive situation in which domestic credit card companies implement their price structure strategy to increase the burden on merchants and lower the burden on cardholders to further increase CTV; second, as mentioned above, since the expected relative utility derived by merchants by participating in the credit card market is greater than that of cardholders, there is more incentive for merchants to accept a relatively high price structure compared to cardholders; third, the relevant regulations exist so that merchants and cardholders are prohibited from neutralizing this price structure through negotiation, and the legal obligation of merchants to accept card payments limits their bargaining power against credit card companies.

The control variables, which were included in the model to prevent endogeneity arising from the omission of other factors that may affect CTV, are described in Table 2. After analyzing the effect of RPR on CTV, the dependent variable is replaced with the MS of

Variables	Definition	Calculation method
$\Delta CTV_{i,t}$	Rate of change in the card transaction volume	Quarterly difference in the log of card (credit card + debit card + prepaid card) transaction volume as the dependent variable
$\Delta MS_{i,t}$	Rate of change in the market share	Quarterly difference in the log of market share (card transaction volume of individual credit card companies ÷ total card transaction volume of seven credit card companies) as the dependent variable
$\Delta RPR_{i,t}$	Rate of change in the relative price ratio	As an explanatory variable representing the price structure of two-sided markets, this variable is given by the quarterly difference in the log of the value obtained by dividing the merchant discount rate by the annual cardholder membership fee rate
$\Delta TPR_{i,t}$	Rate of change in the total price rate	As a control variable that represents the price level in two-sided markets, this variable is given by the quarterly difference in the log of the ratio of the sum of merchant discount revenue and annual cardholder membership fee revenue (i.e. merchant discount rate + annual cardholder membership fee rate) divided by card transaction volume
ΔCPI_t	Rate of change in the customer price index	Quarterly difference in the log of the customer price index announced by Statistics Korea
$\Delta CCSI_t$	Rate of change in the consumer composite sentiment index	Quarterly difference in the log of the quarterly average of the monthly data of the consumer composite sentiment index announced by the Bank of Korea
ΔGDP_t	Rate of change in the real gross domestic product (GDP)	Rate of change from the previous quarter of real GDP, which presents the status of the economy
$\Delta BADLR_{i,t}$	Rate of change in the bad loan ratio	Quarterly difference in the log of the ratio of bad loans to total loans
$\Delta OE_{i,t}$	Rate of change in other expenses, including marketing expenses	Quarterly difference in the log of other card expenses (marketing expenses, card member recruitment expenses, affiliate expenses, card issuance expenses, etc.)
$\Delta PCS_{i,t}$	Rate of change in the prepaid card sales	As a control variable to control the size of the increase in credit card transaction volume, this variable represents the quarterly difference in the log of the amount paid in advance by the credit card company to the merchant for the cardholder's card usage amount
$\Delta CCR_{i,t}$	Rate of change in the check card ratio	As a control variable to control changes in the merchant discount rate due to changes in the check card usage ratio, this variable represents the quarterly difference in the log of the check card usage ratio ((check(debit) card transaction volume ÷ card transaction volume)

Note(s): This table presents the definitions of the variables used in this study and describes how they are calculated. The merchant discount rate is obtained by dividing the merchant discount revenue by card transaction volume, while the cardholder annual membership fee rate is obtained by dividing the cardholder annual membership fee revenue by card transaction volume. These are the standardized prices for card transaction volume

Table 2.
Variable definitions and calculation methods

individual card companies for further analysis. If the RPR affects not only the CTV but also the MS of credit card companies, the effect of the price structure on CTV will become more evident. Based on previous studies and the current status of the Korean credit card market, the regression coefficients for each independent variable are predicted as shown in Table 3.

The data to be analyzed is panel data composed of 31 quarters (t) of seven card companies (i). Using the panel linear regression model shown below, the panel data has the advantage of considering the unobserved heterogeneity (u_i) between individuals, which cannot be considered in cross-sectional data analysis.

Variables	Predicted sign of influence	Remarks
$\Delta RPR_{i,t}$	Positive(+)	Explanatory variable
$\Delta TPR_{i,t}$	Negative(−)	Control variable
ΔCPI_t	Positive(+)	Exogenous control variable
$\Delta CCSI_t$	Positive(+)	Exogenous control variable
ΔGDP_t	Positive(+)	Exogenous control variable
$\Delta BADLR_{i,t}$	Negative(−)	Control variable
$\Delta OE_{i,t}$	Positive(+)	Control variable
$\Delta PCS_{i,t}$	Positive(+)	Control variable
$\Delta CCR_{i,t}$	Negative(−)	Control variable

Table 3. Predicted signs of variables

Note(s): This table shows the predicted signs of the relationships among each variable and card usage performance. When the dependent variables are replaced with market share, predictions about the signs of the relationships remain the same

$$y_{i,t} = \alpha + \beta x_{i,t} + u_i + e_{i,t}, \qquad i = 1, 2, \cdots, n \text{ and } t = 1, 2, \cdots, T \tag{9}$$

However, since the differencing value of the log of variables is used to stabilize the time series data and to enable the easy interpretation of the regression coefficients, the error term (u_i), which represents the intrinsic characteristics of panel objects that are not affected by time, is removed so that consistent estimators can be obtained using the pooled ordinary least squares (OLS) or panel generalized least squares (GLS) methods. To use a reliable and correct estimation method, we tested whether a unit root exists in the panel data and whether first-order autocorrelation or heteroscedasticity of the error term exists in the panel regression analysis.

Equation (10) represents Model 1, which analyzes the effect of the RPR, an explanatory variable representing the price structure, on CTV when the price level, which is the control variable, is fixed. Equation (11) represents Model 2, wherein the dependent variable of Model 1 is replaced by MS. Since MS is a relative concept between credit card companies, exogenous variables, such as the CPI, the CCSI and the GDP change rate, which have the same effect on all credit card companies, are excluded from Model 2.

$$\begin{aligned}\Delta CTV_{i,t} = {} & \alpha + \beta_1 \Delta RPR_{i,t} + \beta_2 \Delta TPR_{i,t} + \beta_3 \Delta CPI_t + \beta_4 \Delta CCSI_t + \beta_5 \Delta GDP_t \\ & + \beta_6 \Delta BADLR_{i,t} + \beta_7 \Delta OE_{i,t} + \beta_8 \Delta PCS_{i,t} + \beta_9 \Delta CCR_{i,t} \\ & + e_{i,t}\end{aligned} \tag{10}$$

$$\begin{aligned}\Delta MS_{i,t} = {} & \alpha + \beta_1 \Delta RPR_{i,t} + \beta_2 \Delta TPR_{i,t} + \beta_3 \Delta BADLR_{i,t} + \beta_4 \Delta OE_{i,t} + \beta_5 \Delta PCS_{i,t} \\ & + \beta_6 \Delta CCR_{i,t} + e_{i,t}\end{aligned} \tag{11}$$

4.2 Summary of descriptive statistics and correlation analysis

As shown in Panel A of Table 4, the annual CTV of the Korean credit card market increased from KRW 509tn in 2011 to KRW 833tn in 2018. During the analysis period, the merchant discount rate fell by 0.337%p from 1.855% to 1.518%, while the cardholder annual membership fee rate increased from 0.113 to 0.150% [21]. The RPR (multiple), which means the relative burden of merchants compared to cardholders, fell from 16.416 to 10.120, while the price level, i.e. the sum of the merchant discount rate and the cardholder annual membership fee rate, reduced from 1.968% to 1.668%.

During the analysis period, the average of the quarterly RPR was 13.54 as shown in Panel B of Table 4, which means that merchants paid 13.54 times more on average compared to the

cardholders. The average of the TPR is 1.79%, which is composed of the average of merchant discount rate (1.65%) and the average cardholder annual membership fee rate (0.14%).

As shown in Figure 2, the order of the MSs of the credit card companies is as follows: Shinhan, Kookmin, Samsung, Hyundai, Woori, Hana and Lotte Card from the top. It is based on the period from the first quarter of 2015 to the third quarter of 2018, when all seven credit card companies competed against each other. There was no change in the relative rankings, which indicates that the competitive structure of the domestic credit card market was fixed.

Since the main variables of this study, $\Delta CTV_{i,t}$, $\Delta MS_{i,t}$, $\Delta RPR_{i,t}$, and $\Delta TPR_{i,t}$ have outliers, as shown in Figure 3, we applied a 97% winsorization to these variables. Table 5 presents the descriptive statistics of the variables in the analysis model. The value of each variable is the rate of change compared to the previous quarter. The average values of $\Delta CTV_{i,t}$, $\Delta RPR_{i,t}$, and $\Delta TPR_{i,t}$ are 2.07%, −2.17% and −0.91%, respectively. These values indicate that, during the analysis period, CTV increased, the relative price of merchants compared to cardholders decreased, and the TPR for card use decreased.

Table 6 presents the correlation matrix. $\Delta CTV_{i,t}$ has a correlation coefficient of 0.3940 with $\Delta RPR_{i,t}$ and −0.6128 with $\Delta TPR_{i,t}$ at the 1% significance level. Additionally, $\Delta CTV_{i,t}$ shows a significant negative correlation with ΔCPI_t, an exogenous control variable. With the other control variables (i.e. $\Delta BADLR_{i,t}$, $\Delta OE_{i,t}$, $\Delta PCS_{i,t}$, $\Delta CCR_{i,t}$), $\Delta CTV_{i,t}$ shows a correlation at the 1% significance level, and these signs are consistent with our conjecture. Another dependent variable, $\Delta MS_{i,t}$, provided similar results; however, the magnitude of its coefficient differs slightly. The negative relationships between $\Delta CTV_{i,t}$ and $\Delta CCR_{i,t}$, as well as $\Delta MS_{i,t}$ and $\Delta CCR_{i,t}$ can be attributed to the increase in the proportion of debit card use, while there was a decrease in the overall growth rate of CTV during the analysis period.

Panel A (Unit: KRW trillion, %, multiple)

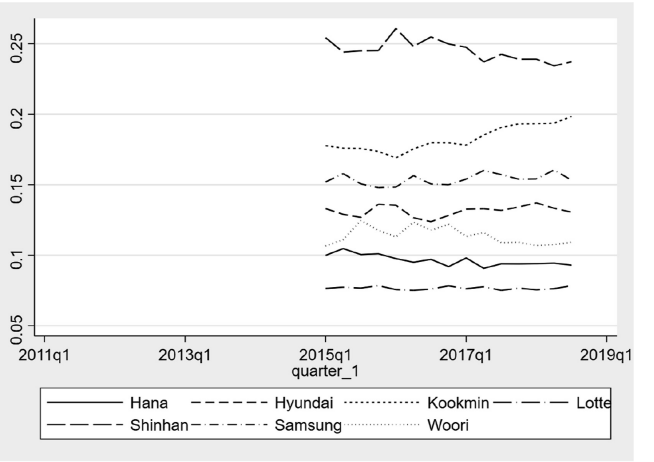
	2011	2012	2013	2014	2015	2016	2017	2018
Card transaction volume	509	560	581	613	666	746	788	833
Relative price ratio (multiple)	16.416	13.146	12.063	12.393	11.738	11.201	10.725	10.120
Total price	1.968	1.839	1.881	1.875	1.796	1.635	1.665	1.668
Merchant discount rate	1.855	1.709	1.737	1.735	1.655	1.501	1.523	1.518
Cardholder annual membership fee rate	0.113	0.130	0.144	0.140	0.141	0.134	0.142	0.150

Panel B (Unit: Multiple, %)

Panel B	N	Mean	STD	Min.	Max.
Relative price ratio (multiple)	190	13.5406	5.8161	6.3075	44.9426
Total price	190	1.7902	0.2623	1.2108	3.4058
Merchant discount rate	190	1.6492	0.2285	1.1270	3.1219
Cardholder annual membership fee rate	190	0.141	0.0583	0.0319	0.2838

Note(s): This table shows the annual card transaction volume, relative price ratio, total price, merchant discount rate and cardholder annual membership fee rate data since 2011. The relative price ratio is calculated by dividing the merchant discount rate by the cardholder annual membership fee rate. Total price refers to the sum of the merchant discount rate and the cardholder annual membership fee rate. The merchant discount rate is calculated by dividing the merchant discount revenue by card transaction volume (sum of credit card, debit card and prepaid card usage), and the cardholder annual membership fee rate is calculated by dividing the cardholder annual membership fee revenue by card transaction volume. Data regarding the merchant discount rate and cardholder annual membership fee rate are available up to the end of September, 2018. Panel A presents the annual data and Panel B presents the descriptive statistics during the sample periods

Table 4.
Card transaction volume and price structure of two-sided markets



Note(s): This figure compares the market shares of Korean credit card companies since the first quarter of 2015. The market shares of only seven Korean credit card companies, except the BC card, were measured

Figure 2.
Market share of credit card companies

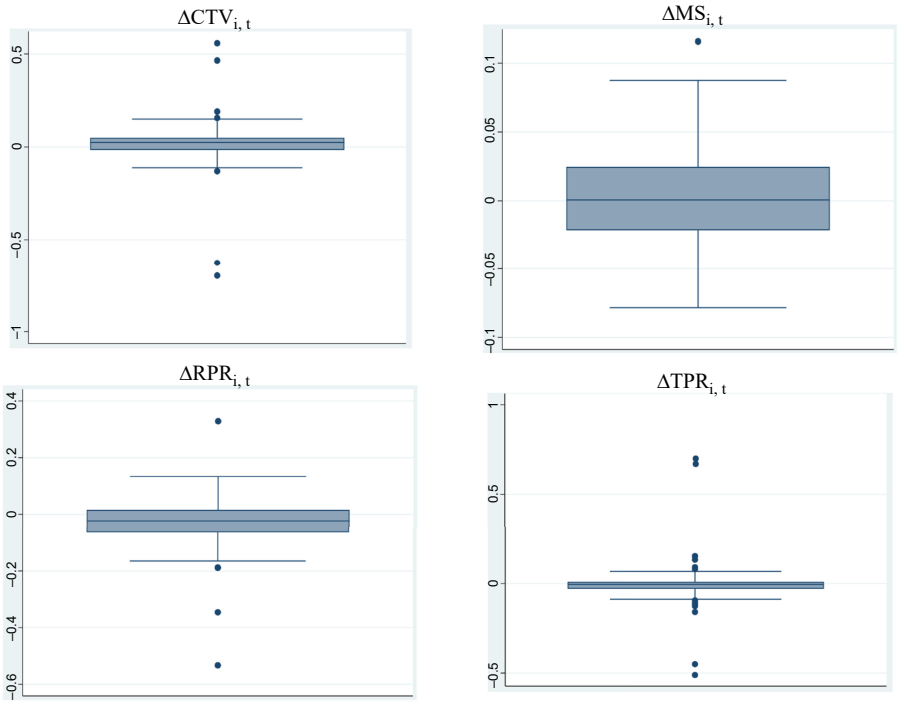
4.3 Unit root test

A panel unit root test was performed to check whether the time-series variables were stationary. For this purpose, we used the Fisher-type and Im-Pesaran-Shin methods. Fisher-type's null hypothesis states that "all panels contain a unit root" and the alternative hypothesis states that "at least one panel is stationary." We utilized the inverse normal static value for the Fisher-type model. According to Im-Pesaran-Shin's null hypothesis, "all panels contain a unit root," while the alternative hypothesis states that "some panels are stationary." As shown in Table 7, the null hypothesis of the unit root test can be rejected at the 1% significance level for all variables. Therefore, in this analysis, all variables do not have a unit root.

4.4 Empirical results

We tested whether heteroscedasticity and autocorrelation of the error term exist in Models 1 and 2. For this purpose, we performed the likelihood ratio (LR) and Wooldridge (2002) tests. According to the test results, the error terms of both models showed homoskedasticity and no autocorrelation; thus, we performed a pooled OLS regression analysis. Additionally, the analysis results obtained from using the fixed effect model, considering individual characteristics (unobserved heterogeneity, u_i), were presented. However, in both Models 1 and 2, the panel individual characteristics of the fixed effect model were not significant, and no systematic difference was observed between the fixed and random effect models under the Hausman test, thus pooled OLS was judged to be an appropriate analysis method.

As reported in Table 8, for Model 1, in both the pooled OLS and fixed effect analyses, the rate of change in relative price ($\Delta RPR_{i,t}$) has a positive coefficient with respect to the rate of change in CTV ($\Delta CTV_{i,t}$) at the 1% significance level, while the rate of changes in TPR ($\Delta TPR_{i,t}$) is controlled. For Model 2, relative price did not have a significant effect on the rate of change in MS ($\Delta MS_{i,t}$). However, the rate of change in other expenses ($\Delta OE_{i,t}$), i.e. marketing expenses, was found to affect $\Delta MS_{i,t}$ at the 10% significance level (p-value = 0.056). In the domestic credit card market, where the competition among credit card companies is fierce, these results indicate



Note(s): This boxplot shows whether the main variables have outliers in their datasets. The variables, Δ $CTV_{i,t}$, Δ $MS_{i,t}$, Δ $RPR_{i,t}$, and Δ $TPR_{i,t}$ represent the rate of change in card transaction volume, market share, relative price ratio, and total price rate, respectively

Figure 3. Boxplot of key variables

	N	Mean	STD	Min.	Max.
$\Delta CTV_{i,t}$	183	0.0206899	0.0514705	−0.0851555	0.1404877
$\Delta MS_{i,t}$	98	−0.0003951	0.0330708	−0.0680964	0.0709311
$\Delta RPR_{i,t}$	183	−0.0217484	0.0601794	−0.1385996	0.1205339
$\Delta TPR_{i,t}$	183	−0.0091277	0.0414831	−0.1186733	0.0917025
ΔCPI_t	210	0.0037649	0.0039353	−0.0042462	0.0123324
$\Delta CCSI_t$	210	−0.0015523	0.0274856	−0.0561895	0.0484304
ΔGDP_t	217	0.0072581	0.0034625	−0.001	0.015
$\Delta BADLR_{i,t}$	187	−0.0055351	0.1639182	−0.9044562	0.5212969
$\Delta OE_{i,t}$	187	0.0325218	0.1727066	−0.3793945	1.691617
$\Delta PCS_{i,t}$	183	0.0170142	0.05398	−0.1585197	0.1824961
$\Delta CCR_{i,t}$	183	−0.0117745	0.1285549	−0.6289034	0.8270998

Note(s): The descriptive statistics of the variables during the sample periods were computed after applying 97% winsorization for card transaction volume (CTV), market share (MS), relative price ratio (RPR) and the total price rate (TPR). Each variable was measured by the rate of change in the values between the previous and current quarters

Table 5. Summary of the descriptive statistics of variables

that marketing expenses related to additional rewards for cardholders, rather than merely adjusting the relative price structure, are necessary to increase a company's market share. The regression coefficient of $\Delta OE_{i,t}$ is 0.055, which indicates that, when $\Delta OE_{i,t}$ increases by 1%p, $\Delta MS_{i,t}$ increases by 0.055%p.

Table 6.
Pearson correlation coefficients

	$\Delta CTV_{i,t}$	$\Delta MS_{i,t}$	$\Delta RPR_{i,t}$	$\Delta TPR_{i,t}$	ΔCPI_t	$\Delta CCSI_t$	ΔGDP_t
$\Delta MS_{i,t}$	0.7173***						
$\Delta RPR_{i,t}$	0.3940***	0.1532					
$\Delta TPR_{i,t}$	−0.6128***	−0.6345***	0.1085				
ΔCPI_t	−0.2920***	−0.0281	−0.3778***	−0.1322*			
$\Delta CCSI_t$	0.1052	0.0647	0.1751**	0.0595	−0.1267*		
ΔGDP_t	−0.0462	−0.0408	−0.0155	0.0153	0.2517***	0.1224*	
$\Delta BADLR_{i,t}$	−0.2952***	−0.2501**	−0.0631	0.1761**	0.1508**	0.0066	0.0694
$\Delta OE_{i,t}$	0.3223***	0.1809*	0.2286***	−0.0019	−0.1805**	−0.0642	−0.2123***
$\Delta PCS_{i,t}$	0.4400***	0.2393**	0.3523***	0.0242	−0.2968***	0.0078	0.0096
$\Delta CCR_{i,t}$	−0.4553***	−0.3931***	−0.1145	0.4248***	0.1287*	−0.0300	0.0915
	$\Delta BADLR_{i,t}$	$\Delta OE_{i,t}$	$\Delta PCS_{i,t}$				
$\Delta OE_{i,t}$	0.0073						
$\Delta PCS_{i,t}$	−0.1044	0.3278***					
$\Delta CCR_{i,t}$	0.1213	−0.1178	−0.1554**				

Note(s): This table presents the correlation matrix. The definitions and measures of the variables are identical to those in Table 2. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively

Variables	Fisher-type	Im-Pesaran-Shin
$\Delta CTV_{i,t}$	−6.3023***	−5.7139***
$\Delta MS_{i,t}$	−3.8969***	−3.3971***
$\Delta RPR_{i,t}$	−4.0879***	−3.7462***
$\Delta TPR_{i,t}$	−8.5950***	−7.7658***
ΔCPI_t	–	–
$\Delta CCSI_t$	–	–
ΔGDP_t	–	–
$\Delta BADLR_{i,t}$	−5.1466***	−4.6840***
$\Delta OE_{i,t}$	−8.0212***	−7.3610***
$\Delta PCS_{i,t}$	−6.1830***	−5.5700***
$\Delta CCR_{i,t}$	−4.2495***	−3.8568***

Note(s): This table presents the panel unit root test results. The Fisher-type and Im-Pesaran-Shin methods were adopted for this analysis. The Fisher-type null hypothesis states that "all panels contain a unit root," while the alternative hypothesis states that "at least one panel is stationary." Thus, inverse normal static values were used for the Fisher-type model. The Im-Pesaran-Shin null hypothesis states that "all panels contain a unit root," while the alternative hypothesis states that "some panels are stationary." Δ CPi,t, Δ CCSi,t and Δ GDPt were excluded from the unit root test since they are exogenous variables and do not differ by individuals. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively

Table 7.
Unit root test results

	$\Delta CTV_{i,t}$ (model 1)		$\Delta MS_{i,t}$ (model 2)	
	Pooled OLS	Fixed effect model	Pooled OLS	Fixed effect model
$\Delta RPR_{i,t}$	0.220***	0.242***	0.061	0.095
	(0.037)	(0.038)	(0.053)	(0.059)
$\Delta TPR_{i,t}$	−0.765***	−0.765***	−0.456***	−0.463***
	(0.054)	(0.054)	(0.059)	(0.060)
ΔCPI_t	−2.000***	−1.872***		
	(0.585)	(0.586)		
$\Delta CCSI_t$	0.105	0.098		
	(0.074)	(0.074)		
ΔGDP_t	0.897	0.841		
	(0.598)	(0.597)		
$\Delta BADLR_{i,t}$	−0.038***	−0.037***	−0.010	−0.012
	(0.012)	(0.012)	(0.017)	(0.017)
$\Delta OE_{i,t}$	0.089***	0.085***	0.055*	0.047
	(0.026)	(0.026)	(0.029)	(0.030)
$\Delta PCS_{i,t}$	0.233***	0.227***	0.196***	0.174***
	(0.042)	(0.042)	(0.057)	(0.060)
$\Delta CCR_{i,t}$	−0.031*	−0.035*	−0.051*	−0.048*
	(0.017)	(0.018)	(0.028)	(0.029)
Constant	0.013***	0.014***	−0.010***	−0.009***
	(0.005)	(0.005)	(0.003)	(0.003)
R-squared	0.753	0.762	0.554	0.565
Observations	183	183	98	98
Group		7		7

Note(s): This table presents the relationship between the rate of change in card transaction volume or market share and the rate of change in each cost measure

$$\Delta CTV_{i,t} = \alpha + \beta_1 \Delta RPR_{i,t} + \beta_2 \Delta TPR_{i,t} + \beta_3 \Delta CPI_t + \beta_4 \Delta CCSI_t + \beta_5 \Delta GDP_t + \beta_6 \Delta BADLR_{i,t} + \beta_7 \Delta OE_{i,t} + \beta_8 \Delta PCS_{i,t} + \beta_9 \Delta CCR_{i,t} + e_{i,t}$$

$$\Delta MS_{i,t} = \alpha + \beta_1 \Delta RPR_{i,t} + \beta_2 \Delta TPR_{i,t} + \beta_3 \Delta BADLR_{i,t} + \beta_4 \Delta OE_{i,t} + \beta_5 \Delta PCS_{i,t} + \beta_6 \Delta CCR_{i,t} + e_{i,t}$$

The definitions and measures of variables are the same as in Table 2, and the figures in parentheses represent the standard errors. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively

Table 8.
Effects of relative price ratio on card transaction volume and market share

In Model 1, $RPR_{i,t}$, $OE_{i,t}$, and $PCS_{i,t}$ had a positive coefficient, while $TPR_{i,t}$, CPI_t, and $BADLR_{i,t}$, had a negative coefficient in all cases at the 1% significance level. Except for ΔCPI_t, all the variables were consistent along the predicted direction. In a previous study by Seo (2016), it was found that the CPI had a positive effect on the use of credit card installments; however, in this study, ΔCPI_t was found to have a negative effect on $\Delta CTV_{i,t}$. This difference is evident in light of the fact that $\Delta CTV_{i,t}$, the dependent variable in this study, includes both credit and debit card usage as well as card installment use, and that ΔCPI_t and the rate of changes in CCSI ($\Delta CCSI_t$) have a negative correlation as shown in Table 6. Considering these factors, we can confirm that, when the CPI rises, consumer sentiment shrinks, and consequently, CTV decreases.

The regression coefficient of $\Delta RPR_{i,t}$ is 0.220, which is the key explanatory variable of the research model, and it can be interpreted as that increase in $\Delta RPR_{i,t}$ by 1%p raises $\Delta CTV_{i,t}$ by 0.22%p. This means that while the price level ($\Delta TPR_{i,t}$) is controlled, the price structure ($\Delta RPR_{i,t}$) still affects the rate of changes in CTV. These empirical results support the conjecture that despite of difference from four-party system, the price structure effect of the two-sided markets theory asserted by Rochet and Tirole (2003, 2006) also exists in the domestic credit card market (three-party system). These results empirically confirm that the price structure effect, a key requirement of the two-sided market theory, exists in the Korean credit card market. Therefore, this study differ significantly from previous overseas studies indirect network externalities, which found that the number of merchants and members mainly affect either credit card usage performance or transaction volume.

4.5 Effect of new CEO inauguration on card transaction volume and price structure

In Korea, when a new CEO takes office in a credit card company, he/she tends to release a new credit card that offers better additional benefits, such as points accumulation and price discounts, compared with the annual membership fee. The new CEO offers this so-called "CEO-designed card" to increase card usage performance and expand the company's MS at the beginning of his/her tenure. An additional analysis was conducted to examine the effect of the inauguration of the CEO of a credit card company and the launch of a new credit card on card usage performance and price structure, which are the main variables considered in this study.

The launch of a "CEO-designed card" that provides additional benefits to members can be viewed as similar to increasing card usage performance by adjusting the relative price to lower the relative burden on members. Therefore, adding the new CEO inauguration event as an explanatory variable in our analysis can be viewed as an alternative model for analyzing the effect of relative prices in a two-sided market on card usage performance. If the relative price fluctuates when a new CEO takes office or the interaction between relative prices and new CEO inauguration affects card usage performance, it will be a case in which the effects of the price structure of a two-sided market can be better understood in the context of the domestic credit card market. An excerpt of an article about "CEO-designed cards" is as follows:

> CEO cards
>
> Following Shinhan Card, Woori Card and Lotte Card launched the CEO-designed card and entered the CEO-designed card competition. The CEO-designed card has high benefits and various launch promotions, so it is an opportunity for card-tech (card + wealth management-tech) for consumers. Korea Financial Times (2018. 4. 23)

In this study, first, the time of CEO inauguration was added as an indicator variable to Model 1 and Model 2 to analyze whether the inauguration of the CEO significantly increases card usage performance. During the analysis period, the CEO took office 16 times. *t* indicates the quarter in which the new CEO took office, *t−1* indicates that the new CEO took office 1 quarter before that quarter, *t−2* and *t−3* indicate that the new CEO took office two and three-quarters ago, respectively.

After testing for homoscedasticity and autocorrelation among the error terms for Models 1 and 2, we found that both Model 1 has heteroscedasticity and no autocorrelation, while Model 2 has homoscedasticity and no autocorrelation. Therefore, for Model 1, we utilized the panel GLS analysis method, which estimates σ_i^2, in addition to the joint OLS method. For both models, according to the Houseman test results, no systematic difference was observed between the fixed and random effects. Since the analysis result regarding the random effect is the same as that of the joint OLS, only the fixed effect model is presented as a reference. However, in the fixed effect model, the test results for the error term (u_i) indicating individual characteristics were not significant. Accordingly, it is judged that the panel GLS model for Model 1 and the joint OLS analysis method for Model 2 are appropriate.

As shown in the analysis results in Table 9, in Model 1, which utilizes the panel GLS method, CTV increased at the 1% significance level before the first quarter (*t−1*), i.e. in the second quarter following the inauguration of the new CEO. This is actually very similar to the time when a new CEO takes office at a credit card company and the "CEO-designed card" is launched on the market. The regression coefficient is 0.017, which can be interpreted as a 1.7%p increase in the CTV in the second quarter after a new CEO takes office. In Model 2, which analyzed the effect of a new CEO's inauguration on a company's MS, no significant relationship was observed between CEO inauguration and MS. However, it was found that $\Delta OE_{i,t}$, which represents marketing expenses, had a positive (+) effect on MS. In the analysis, which did not consider the control effects of these variables, excluding $OE_{i,t}$ and other variables related to price, we found that the MS increased at the 10% significance level (value = 0.072) in the second quarter after the new CEO took office. When a new CEO takes office, it is expected that the company's MS will increase due to the increase in marketing toward members.

Second, based on our analysis of the effect of new CEO inauguration on market price structure, we observed that there was no significant relationship between the two variables. However, as shown in Table 10, the inauguration of a new CEO in a credit card companyaffects $\Delta OE_{i,t}$ (the rate of change of OE representing marketing expenses) at the 10% significance level. Interestingly, $\Delta OE_{i,t}$ decreases (p-value = 0.052) in the first quarter (t) when the CEO takes office, and increases (p-value = 0.088) in the third quarter ($t-2$). In some cases, the marketing costs of credit card companies were recognized as expenses after a certain period of time when members used the card. Therefore, when a CEO is replaced, marketing costs related to card benefits decreases and card benefits increase after a new CEO takes office. As shown in Table 9, card usage performance increases at ($t-1$), and as shown in Table 10, this is viewed as a process wherein marketing costs increase at ($t-2$). Since the inauguration of a new CEO did not have a significant effect on $\Delta RPR_{i,t}$, the increase in card usage performance at the beginning of the new CEO's tenure was not a superficial adjustment between the merchant discount rate and the cardholder membership fee rate, but rather the expansion of marketing expenses such as points accumulation and member discounts. Thus, the increase in card usage performance can be attributed to the intrinsic relative price adjustment that increases cross-subsidies for members at different merchants. In response to this phenomenon, Caillaud and Jullien (2003) found that, due to the indirect network externality, the relevant pricing strategies of operators relaying user groups has the characteristics of a divide-and-conquer strategy, wherein one user group supports costs and the other user group compensates for these costs.

Table 9.
Effects of CEO inauguration on Card Usage Performance and Market Share

	$\Delta CTV_{i,t}$				$\Delta MS_{i,t}$		
	Pooled OLS	Panel GLS	Fixed effect model	Panel GLS	Pooled OLS	Panel GLS	Fixed effect model
$\Delta RPR_{i,t}$	0.217***	0.184***	0.242***	0.236***	0.064		0.100
	(0.037)	(0.034)	(0.038)	(0.043)	(0.055)		(0.061)
$\Delta TPR_{i,t}$	−0.747***	−0.783***	−0.751***	−0.786***	−0.449***		−0.459***
	(0.055)	(0.049)	(0.055)	(0.048)	(0.062)		(0.064)
ΔCPI_t	−2.003***	−2.073***	−1.860***	−2.214***			
	(0.582)	(0.535)	(0.584)	(0.521)			
$\Delta CCSI_t$	0.107	0.123*	0.101	0.100			
	(0.074)	(0.068)	(0.074)	(0.067)			
ΔGDP_t	0.828	0.953*	0.785	1.053*			
	(0.598)	(0.546)	(0.597)	(0.540)			
$\Delta BADLR_{i,t}$	−0.037***	−0.037***	−0.036***	−0.041***	−0.008	−0.031*	−0.010
	(0.012)	(0.011)	(0.012)	(0.011)	(0.018)	(0.022)	(0.019)
$\Delta OE_{i,t}$	0.091***	0.098***	0.086***	0.096***	0.053*		0.045
	(0.026)	(0.024)	(0.026)	(0.025)	(0.030)		(0.031)
$\Delta PCS_{i,t}$	0.227***	0.237***	0.223***	0.218***	0.198***	0.158**	0.178***
	(0.042)	(0.040)	(0.042)	(0.039)	(0.059)	(0.071)	(0.062)
$\Delta CCR_{i,t}$	−0.032*	−0.037**	−0.035*	−0.039**	−0.054*	−0.138***	−0.050*
	(0.017)	(0.017)	(0.018)	(0.017)	(0.029)	(0.033)	(0.030)
CEO(t)	−0.000	0.001	−0.005	0.001	−0.003	−0.009	−0.004
	(0.008)	(0.007)	(0.008)	(0.007)	(0.011)	(0.013)	(0.011)
CEO(t−1)	0.015**	0.017***	0.011	0.011*	0.003	0.020*	0.003
	(0.007)	(0.006)	(0.007)	(0.007)	(0.009)	(0.011)	(0.010)
CEO(t−2)	−0.007	−0.006	−0.011	−0.007	0.001	0.004	0.000
	(0.007)	(0.006)	(0.007)	(0.006)	(0.009)	(0.011)	(0.009)
CEO(t−3)	0.002	0.005	−0.001	0.003	0.006	0.005	0.008
	(0.008)	(0.007)	(0.008)	(0.007)	(0.010)	(0.013)	(0.011)
$CEO(t) \times \Delta RPR_{i,t}$				−0.018 (0.092)			
$CEO(t-1) \times \Delta RPR_{i,t}$				−0.350*** (0.117)			
$CEO(t-2) \times \Delta RPR_{i,t}$				−0.154 (0.102)			
$CEO(t-3) \times \Delta RPR_{i,t}$				−0.042 (0.107)			
Constant	0.013***	0.010**	0.015***	0.012**	−0.010***	−0.008*	−0.009**
	(0.005)	(0.005)	(0.005)	(0.005)	(0.003)	(0.004)	(0.004)
R-squared	0.762		0.770		0.557	0.270	0.569
Observations	183	183	183	183	98	98	98
Group		7	7	7		7	7

Note(s): This table presents the relationship between the rate of change in card transaction volume or market share and CEO inauguration, which was analyzed using pooled ordinary least squares (OLS), panel generalized least squares (GLS), and the fixed effect model. CEO(*t*) represents the time of CEO inauguration. t represents the quarter in which the new CEO takes office, while *t*–1 represents the quarter before the new CEO took office, and so on. The definitions and measures of the other variables are the same as in Table 2, and the figures in parentheses denote the standard errors. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively

	Δ RPR$_{i,t}$	Δ OE$_{i,t}$
ΔCCR$_{i,t}$	−0.055 (0.035)	−0.073* (0.035)
CEO(t)	0.006	−0.041*
	(0.018)	(0.021)
CEO(t−1)	0.012	0.004
	(0.016)	(0.019)
CEO(t−2)	0.008	0.033*
	(0.016)	(0.019)
CEO(t−3)	−0.005	−0.001
	(0.018)	(0.021)
Constant	−0.024***	0.017**
	(0.005)	(0.007)
R-squared	0.018	0.057
Observations	183	183

Note(s): This table represents the relationship between rate of change in relative price ratio or other expenses and CEO inauguration. The figures in parentheses denote the standard errors. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively

Table 10. Effects of CEO inauguration on relative price ratio and marketing cost

Finally, as shown in Table 9, the effect of the interaction term between CEO inauguration and the relative price ratio ($CEO(t\text{-}1) \times RPR_{i,t}$) had a significant and negative effect on card usage performance ($CTV_{i,t}$). This means that, in the second quarter following the new CEO's inauguration, the effect of RPR on card usage performance depends on the level of a negative moderator. As suggested in the first analysis' result, the second quarter following the inauguration of a new CEO is the period during which card usage increases due to provision of the CEO-designed card that provides additional benefits. As mentioned above, the increase in credit card usage right after a new CEO takes office can be attributed to marketing expansion rather than the superficial relative price adjustments.

4.6 Endogeneity problem

The basic assumption of this study is that changes in price structure can cause changes in card usage performance. This endogenous causal relationship can be eliminated if the explanatory variable and the control variable are used earlier than the dependent variable in the model. Since the data utilized in this study are quarterly data, it is difficult to explain the changes in card usage performance caused by exogenous factors and the market price structure in the previous quarter. Additionally, since the difference variable was used to maintain time-series stability and the explanatory power of the model was lowered due to the lag introduced during the analysis, lag values were not used as the independent variable.

This approach may present the problem of inverse causality in the research model, wherein relative prices may change as card usage performance changes. To support the model's causal relationship, wherein changes in the relative prices, representing the price structure, affect card usage performance, we performed the panel Granger causality test and IRF analysis according to the panel vector autoregressive (Panel-VAR) model.

In the panel data structure, as shown in Panel A of Table 11, the DH (Dumitrescu and Hurlin, 2012) test result showed that relative prices had a Granger causality effect on card usage performance at the 10% significance level (p-value = 0.0756). In the test using the Panel-VAR model, as shown in Panel B of Table 11, the relative price led to a card usage performance at the 10% significance level (p-value = 0.080).

Figure 4 illustrates the IRF analysis results, i.e. RPR had a positive (+) effect on card usage performance until a time lag of 6. When the time lag exceeded 6, this effect became insignificant since 0 was included in the confidence interval (75%).

Panel A: Dumitrescu and Hurlin (DH) test	X→Y	X←Y
Z-bar	1.7769	0.8061
p-value	0.0756	0.4202
Panel B: Panel-VAR model test	**X→Y**	**X←Y**
χ^2	5.063	0.034
prob > χ^2	0.080	0.983

Note(s): This table presents the results of the Grandeur causality test of the relationship between relative price ratio and card usage performance. Panel A presents the Dumitrescu and Hurlin (DH) test results and Panel B presents the results of the Panel-VAR model test. X represents the logarithm of the relative price ratio, while B is the logarithm of card usage performance. The results indicate a normal time series with no unit root at the 1% and 5% significance levels, respectively, and satisfies the test requirements. Lotte Card, Samsung Card, Shinhan Card and Hyundai Card were used in the analysis since they did not have any missing values during the sample period. The lag time was set to two periods, which corresponds to the minimum Akaike information criterion (AIC) among Lag1~Lag3

Table 11.
Results of the grandeur causality test of the relationship between relative price ratio and card usage performance

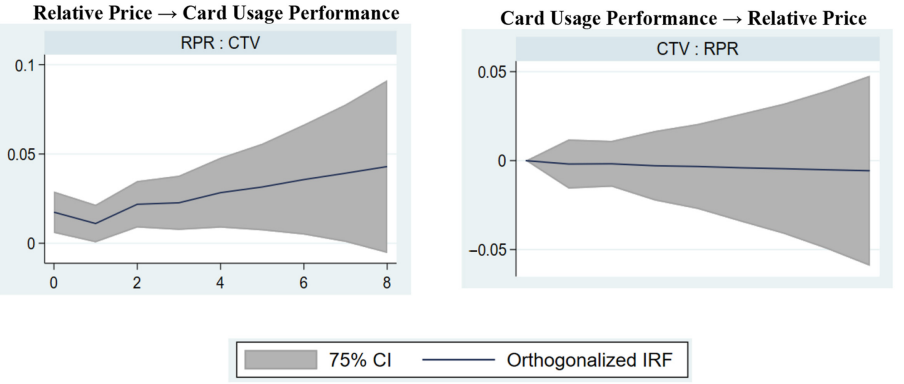


Figure 4.
Results of the impact response function (IRF) analysis of the relationship between relative price ratio and card usage performance

Note(s): This figure illustrates the results of the IRF analysis of the relationship between relative price ratio (RPR) and card usage performance (CTV). In the analysis, the logarithm values of the relative price ratio and card usage performance were used. Moreover, Lotte Card, Samsung Card, Shinhan Card, and Hyundai Card were analyzed since they did not have any missing values during the analysis period

5. Conclusion

Previous related research has mainly focused on understanding the Korean credit card market wherein the merchant discount rate is borne by affiliated stores. This study differs from previous model-oriented studies and expands the literature on credit card markets. In particular, this study adopts the two-sided market theory, which is based on the relative price burden (fee) between merchants and cardholders, and analyzes the effect of price structure, in terms of the merchant discount rate and the cardholder annual membership fee, on card usage performance. Additionally, although the Korean credit card market system (three-party system) differs from those in the U.S. or Europe (four-party system), this study empirically analyzes the effect of the price structure of two-sided markets on card usage

performance, focusing on the institutional specificity of the domestic credit card market, which meets the conditions of a two-sided market such as a mandatory credit card payment system and the prohibition of surcharges for credit card payments.

The findings of this research are discussed below. First, the relative price rate (i.e. merchant discount rate ÷ cardholder annual membership fee rate), which represents the price structure, significantly and positively (+) affects card usage performance when TPR (merchant discount rate + cardholder annual membership fee rate), which represents the price level, is controlled. This finding is consistent with the two-sided market theory and implies that, in the domestic credit card market, the higher the price burden of merchants compared with that of the cardholders, the better the card usage performance.

Second, when a new CEO takes office in a credit card company, card usage performance as well as the company's MS increases significantly. This finding can be attributed to the launch of the so-called "CEO-designed card," which expands the benefits obtained by consumers in using the card, when a new CEO takes office.

These results support our conjecture that, as claimed by Rochet and Tirole's (2003, 2006, 2011) and other scholars, the two-sided-market price structure affects card usage performance and MS in the Korean credit card market. Additionally, this study empirically proved that the Korean credit card market operates using the theoretical mechanism of two-sided markets despite having a different market system.

The existence of the price structure effect in the Korean credit card market explains why credit card companies set higher merchant discount rates than cardholder annual membership fees. However, whether the increase in merchant sales due to the effects of the two-sided-market price structure leads to an increase in the profits of merchants, there is room for different judgments due to exposure to tax sources and other tax burdens included in sales. Moreover, considering the reality that the competition among credit card companies tends to focus on cardholdersdue to the regulations, such as the mandatory credit card payment system, which limits the bargaining power of merchants, the effect of a price structure that promotes member card use and increases merchant sales is one of the most important characteristics of the credit card market and must be considered when establishing policies related to merchant discount rates. This is because merchant discount rates are the typical prices in a two-sided market and hence, lowering them could increase the burden on members and reduce the effectiveness of the entire credit card payment system.

Notes

1. The card usage record of domestic members includes records for credit cards that pay for usage after a certain period (credit grant period by credit card company) has elapsed when a member purchases goods or services using a card (Specialized Credit Finance Business Act, Article 2, No. 3), the record for a debit card that directly transfers the purchasing price amount from the account (Specialized Credit Finance Business Act, Article 2, No. 6), the record for a card that functions as both a debit and credit card (Article 6-7, Paragraph 3, Item 1 of the Enforcement Decree of the Specialized Credit Finance Business Act, B), and the record for a prepaid card wherein users pay a certain amount of money in advance (Specialized Credit Finance Business Act, Article 2, No. 8). Among these cards, credit cards and debit cards account for 99.9% of card usage.
2. In this context, the same product is sold to buyers at different prices; however, according to the two-sided market theory, this price structure, i.e. relative price burden of two user groups in using a platform, is characteristic of a two-sided market.
3. In the domestic and overseas credit card markets, card users can easily use the cards of other credit card companies' (multi-homing) if the usage fees, such as annual membership fees, charged by a credit card company increases. However, for merchants, it is difficult to reject or select a particular card, as merchant discount fees rises, especially if the merchant is not very large in size.

4. Recently, in the U.S., Europe and Australia, the use of BNPL (buy now, pay later) services, similar to credit cards, has been growing among young people with a high consumption desires but low credit (thin-filer). Although this service is free for members, it has a price structure that imposes high fees (approximately 5–6% of the amount paid by customers) for merchants; however, merchants expect that the service will lead to increased sales from new customers and accept these high fees.
5. Rochet and Tirole (2003, 2006) presented the impossibility of additional payments as an important condition of a two-sided market. Moreover, Evans (2003) suggested another condition that direct transactions between user groups should be impossible to enable platform operators to charge discriminatory fees to both sides.
6. According to Paragraph 1 of Article 19 (Matters to be observed by merchants) of the Credit Specialized Financial Business Act, "merchants shall not refuse credit card payment or treat credit card holders unfavorably because of transaction by credit card." Additionally, Paragraph 4 states that "credit card merchants shall not charge card holders merchant discounts."
7. The acquirer's business involves collecting the transaction slips generated after a merchant receives the card, submitting it to the card issuer, and paying the sales price to the merchant. In Korea, credit card companies undertake this activity on their own.
8. Jang (2008) analyzed the effect of the number of affiliated stores and card issuances on card usage performance. The interaction variable between the number of merchants and card issuances was found to have a positive effect on the total card usage. Thus, the credit card market has a positive externality between two groups: merchants and members. Additionally, Evans (2003) and Rysman (2007) confirmed the presence of a positive correlation in analyzing the effect of the number of affiliated stores and members on card use performance or number of card use cases.
9. Lee (2011) suggests that, if all merchants accept card payments, card companies will have no incentive to compete for merchant discounts. His model showed that, when cardholder fees and merchant discounts are determined by the market autonomously, cardholder fees tend to be lower than the social optimum, while merchant discounts are set at the highest level, satisfying the conditions for all merchants to accept card payments.
10. It is the value obtained by dividing the annual membership fee revenue of the credit card company by CTV; it is the standardized value of the price paid by cardholders based on CTV.
11. Since Rochet and Tirole (2006) defined the trading volume of a two-sided market as the product of demand on both sides, the formula for maximizing it was similar to the isoperimetric problem of creating a rectangle with the largest area with a string of limited length.
12. Price discrimination has the same meaning as the price structure in this study, but the term used by the original researcher is cited as it is in consideration of referring to previous studies.
13. From 1981 to 2001, the log of the number of Visa card transactions was regression-analyzed against the log values of the number of merchants and cardholders. According to the regression analysis, the regression coefficient of the merchant variable was 1.73, while the regression coefficient of the cardholder variable was 0.84.
14. Visa and MasterCard in the U.S. are not credit card companies like Korea but card network companies in which card issuers, such as banks, have signed up as members and operate a card payment network that connects card issuers and merchants.
15. The U.S. Supreme Court ruled that American Express Card ("AMEX Card")'s anti-steering rule clause made it impossible for AMEX card merchants to solicit credit cards with lower merchant fees for customers. The final ruling was that this was not an anti-competitive act, going against the lawsuit filed by the U.S. Department of Justice and state governments, which stated that it was an anti-competitive act that limits competition between businesses and results in higher prices for franchisees and consumers.
16. The main revenue of the BC Card is not merchant fees for card use, but service fees for the commercial banks' card payment services.

17. Qualifying costs are expenses that must be reasonably borne by credit card merchants. According to Article 25-4 of the Regulation on Supervision of Specialized Credit Financial Business, only these expenses should be reflected in the calculation of the merchant discount rate, and the merchant should not bear any expenses un-related to the services provided by credit card companies.
18. Since the fourth quarter of 2018, due to the changes in the accounting standards, the merchant discount fee statistics in the Financial Statistical Information System of the Financial Supervisory Service have been changed to deduct the consideration paid to customers, not the total amount of merchant discount fees. This does not conform with our research method and hence, it was impossible to compare this data with existing data.
19. The PCS means the amount paid in advance by the credit card company to the merchant store for the cardholder's card usage.
20. Since the merchant discount rate of check card is lower than that of credit card, if the proportion of check card usage changes among total card usage, the merchant discount rate, the subject of the study, changes. In addition, the use of debit cards increased in Korea due to policy support such as expansion of income deductions other than market variable.
21. It is difficult to interpret that the actual burden of cardholders has increased as the additional rewards for members are not taken into account. It can be seen that the recent change in consumer preference for credit cards (e.g. premium cards) with relatively high membership fees and various additional services has been reflected.

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