Price Negotiation with Merchant Heterogeneity in the Payment Card Industry*

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Abstract

We examine negotiated pricing in the payment card industry by exploiting a unique merchant-industry-city-level dataset from China. We establish that there are substantial variations in the fee paid by merchants to acquirers, i.e., the acquirer fee. By estimating an acquirer fee bargaining model between an acquirer and a merchant, we find that the acquirer fee is determined by the acquirer cost, the net incremental surplus from card services enjoyed by the merchant and the bargaining power of the acquirer against the merchant. Bargaining power is heterogeneous across merchants; in particular, larger merchants pay a lower acquirer fee than their smaller counterparts. Furthermore, the merchant-specific surplus is a main driver of the variation in incremental surplus from card services across merchants. This suggests that industry-level regulation on acquirer fees across merchants would, on the one hand, level the playing field between large and small merchants. On the other hand, it might hinder card usage because it ignores the heterogeneity of merchants' willingness to pay for card services.

Keywords: Payment card, Nash bargaining, Variance decomposition, Regulation
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1 Introduction

Suppliers and buyers often negotiate over prices in business-to-business markets, such as cable TV (Crawford and Yurukoglu, 2012), hospital services (Gowrisankaran, Nevo, and Town, 2015; Ho and Lee, 2017) and medical devices (Grennan, 2013). This paper examines the price negotiation in the payment card industry, which is novel to the empirical literature on bargaining and payment cards. Merchants who use card services need to pay a portion of their sales as a merchant discount. The merchant discount consists of an interchange fee paid to the card issuer, a network fee to the card network and an acquirer fee to the acquirer who processes the transaction for the merchant.

The acquirer fee has become an important part of the merchant discount since the interchange fee has declined in many countries (such as Australia, China, Spain and the U.S.) due to regulatory and legal actions caused by merchant complaints about extremely high interchange fees[1] and because the regulated network fee has been maintained at a relatively low level. Although the interchange and network fees are non-negotiable, merchants can negotiate with acquirers over their fee.[2] As a result, even for identical card services, there can be substantial variations in acquirer fees because there are significant variations in the willingness to pay of merchants, the cost of providing card services and the relative bargaining power between acquirers and merchants.

The payment industry is important per se because it is the backbone of a well-functioning financial market and the usage of payment cards dramatically decreases the cost of transactions. Accordingly, policymakers may consider regulating acquirer fees to efficiently promote card usage. One apparent motive in regulating the acquirer fee is the desire to prevent the potential anticompetitive effects of price discrimination.[3] However,

[1] Merchants have complained that card networks and their card issuers have used market power to set high interchange fees, which drives up merchant discounts. Consequently, this criticism led to regulatory and legal actions from merchants and governments (see Bradford and Hayashi (2008) as an example) and the increasing interest of researchers in interchange fees (see Rysman and Wright, 2014).

[2] Anecdotally, the acquirer fee contributes a larger portion of the merchant discount for merchants using fixed pricing because fixed pricing typically overcharges the interchange and network fees for debit cards.

[3] For example, large-sized merchants often pay a lower acquirer fee than small-sized merchants (Kjos, 2007; Bounie, François, and Van Hove, 2017) through bilateral negotiations. Such price discrimination may disadvantage small retailers competing against large ones, such as chain stores. Moreover, such a situation may violate the spirit of price discrimination laws for protecting intermediate goods competition. These laws include, for example, the Robinson-Patman Act (1936) in the U.S. and Article 102 TFEU (ex Article 82 EC, ex Article 86 EC) in the EU.

an industry-specific regulation of acquirer fee, in the presence of substantial heterogeneity in merchant-specific surplus from card services within an industry, may hinder the promotion of card usage. If the regulated fee is too high, those merchants with low surplus from using card services would not accept card usage; if the regulated fee is too low to cover the acquirer's cost of card services for some merchants, the acquirer would not offer card services to those merchants. Therefore, whether an industry-specific regulation on the acquirer fee is appropriate should be based on the heterogeneity in merchants' surplus from card services.

This paper provides a structural framework to quantify the heterogeneity of merchant bargaining power against the acquirer and of merchants' incremental surplus from card services and, in turn, evaluate the relevance of regulating the acquirer fee. To this end, we first employ the widely used Nash bargaining solution to model the acquirer fee negotiated between acquirer and merchant, in which they divide the total surplus from card services through the acquirer fee. Because bargaining power affects the division of the incremental surplus from card services, our model allows the bargaining power of merchants to depend on their characteristics, thereby allowing us to identify sources of bargaining power. Utilizing the structural model, we estimate the incremental surplus from card services and then decompose it into three components, namely, an industry-specific surplus, a city-specific surplus and a merchant-specific surplus. Based on the estimates of the model, we then use variance decomposition techniques to quantify the magnitude of variations for the three aforementioned components, which allows us to evaluate the relevance of industry-specific fee regulation.

Our dataset is rich at the industry-city-merchant level and provides information on merchant payments to the card network, card transaction values and value per transaction, which allow us to compute the merchant discount paid by each merchant. Because the interchange and network fees are regulated and publicly disclosed, we compute the acquirer fee paid by each merchant by subtracting the interchange and network fees from the merchant discount. Then, we complement the data by matching them to an industry-level dataset regarding operating revenue, operating cost and card fraud risk and a city-level dataset containing GDP per capita and demographics. Overall, our dataset covers more than 6,000 merchants operating in 72 industries and located in 20 cities in Guangdong

Province in 2004.[4]

Despite the growing importance of acquirer fees, their pricing continues to primarily be discussed among policy makers (Kjos, 2007) and practitioners (Capgemini, 2012). There is no empirical study on the pricing of acquirer fees at the merchant level due to a lack of data. This paper exploits a unique dataset from China to analyze the pricing of acquirer fees. Our dataset is particularly suitable for investigating the regulatory issues surrounding acquirer fees because they were still fully deregulated in our sample period, and there has been some controversy over regulating acquiring fees in China. In addition, our sample province contains one acquirer, while there are multiple acquirers in other Chinese provinces.[5] Consequently, the acquirer's bargaining power in other provinces tends to be weaker due to the potential competition among acquirers than that in our sample province. In other words, our estimate of bargaining power might be regarded as the upper bound of bargaining power in the presence of multiple acquirers.

We estimate the model and explore various regulatory implications based on the empirical results. First, we find that the industry-specific surplus depends negatively on the card penetration rate and that the acquirer's cost of providing card services is non-trivial. These results are consistent with a higher surplus from card services when consumers' card usage is not yet widespread. The bargaining power of the acquirer increases with the value per card transaction and decreases with the total card transaction value of a merchant. Not only does having an alternative payment method for transactions with a small amount boost the bargaining power of merchants against the acquirer, our results also suggest that there is a scale advantage for merchants in bargaining with the acquirer. Second, the bargaining power of the acquirer is weaker than that of merchants, which appears odd at first glance because our sample province had a monopoly acquirer during the sample year. Indeed, this result can be ascribed to the acquirer's use of a low-price strategy to nurture the merchant's habit of card usage when POS machine installations

[4]Guangdong Province is located in the coastal area of southern China. Economic reforms were implemented in this province in 1980, including the establishment of special economic zones, which attracted foreign trade and investment and promoted private enterprise. Moreover, in 2004, Guangdong ranked sixth in of GDP per capita and had a ratio of GDP per capita to the national average of 1.47. To place this figure in perspective, Delaware and Connecticut had similar ratios of GDP per capita to the U.S. national average in 2004.

[5]For the Chinese market, our sample acquirer was the largest firm, with approximately 40% of the market share in 2015 (China International Capital Corporation 2017), and the top-10 acquirers occupied approximately 80% of the market in 2014 (China Payment Industry Report 2015 by Payment Clearing Association of China).

were not widespread. In other words, the acquirer leaves more surplus to merchants and provides higher powered incentives for merchants to use card services.

Third, based on the estimation results, our counterfactual analysis reveals that large merchants pay a lower acquirer fee than small merchants, which provides a cost advantage to large merchants against small merchants. Nonetheless, our variance decomposition results indicate that the merchant-specific surplus is a main driver of the incremental surplus from card services. Although our sample period was characterized by no regulation of acquirer fees, there were periods with industry-specific regulation of acquirer fees. Our results highlight the policy trade-off that, on the one hand, industry-specific regulations on acquirer fees may not efficiently allocate payment card usage across merchants because merchants differ in their willingness to pay for using card services. On the other hand, if the acquirer fee is completely determined through bilateral negotiation between merchant and acquirer, large-sized merchants have greater bargaining power and hence pay a lower acquirer fee than small-sized merchants. Such price discrimination may disadvantage small retailers in competition against large ones and violate the spirit of laws concerning protecting competition, especially in the intermediate goods market.

This paper contributes to the literature regarding the pricing of acquirer fees in three respects. First, we provide new evidence concerning the pricing of acquirer fees at the merchant level. To our knowledge, Guibourg and Segendorff (2007) is the only work to empirically examine the acquirer fee. They utilize aggregate data from the four largest Swedish banks and find that banks generally charge a variable acquirer fee to merchants. Second, we construct a Nash bargaining model to analyze how the acquire fee is determined. In particular, we study how merchants' observed characteristics affect the acquirer fee through heterogeneous bargaining power. Although our model has the limitation of including only a single acquirer, it can nevertheless be applied in various acquiring markets with one acquirer, such as Brazil (Redecard for MasterCard and VisaNet for Visa until 2010), Chile (Transbank for debit and credit cards), and Denmark (Nets for the Dankort debit card, which dominates the market). Third, we use variance decomposition methods to quantify sources of variation in the incremental surplus from card services. The decomposition also allows us to draw implications on industry-specific regulations on acquirer fees. Although there is no prior literature on the regulation of acquirer fees, there are works studying the regulation of interchange fees (see Rysman and Wright (2014) for

a review). Our paper complements their work by studying an alternative regulation of payment card pricing. Generally, our findings are also relevant for policy makers seeking to regulate prices, such as antitrust authorities concerned about price discrimination in intermediate goods markets.

In addition to improving our understanding of the payment card industry, our study adds to the empirical bargaining literature by introducing novel methods of decomposing price dispersion. Grennan and Swanson (2018) decompose the contributions of demand heterogeneity and bargaining power to the dispersion of prices paid by hospitals for a particular type of medical device. They perform their decomposition by computing the counterfactual price dispersion by shutting down demand heterogeneity or bargaining power. Our method differs from theirs in relying on relevant statistical methods to evaluate the relative importance of each individual regressor in terms of its contribution to the variation in the dependent variable. Because regressors are typically correlated, it is not straightforward to break down the model R^2 (coefficient of determination) into shares from the individual regressors. Therefore, Lindeman, Merenda, and Gold (1980) and Feldman (2005) use the sequential sums of R^2 from the linear model to obtain an overall assessment by averaging over all orderings of regressors. We follow their methods to compute the relative importance of industry-specific surplus, city-specific surplus and merchant-specific surplus. More broadly, the variance decomposition methods used in this paper can disentangle and gauge the sources of price variations in other markets and yield insights into the potential drawbacks of banning price discrimination.

Finally, we contribute a novel empirical methodology by deriving closed-form formulas for those two methods of variance decomposition for a linear model with three regressors. In a widely cited paper, Grömping (2007) focuses solely on a linear model with two regressors, but explicit formulas for variance decomposition for a linear model with three regressors are nontrivial extensions of those with two regressors because several properties of the results with two regressors cannot be generalized to models with more than two regressors. The closed-form formulas for variance decomposition derived in our paper allow those decomposition methods to applied in a wider variety of economic models.

The remaining sections proceed as follows. Section 2 discusses the industry background and data. Section 3 presents the data and descriptive analysis. Section 4 provides a structural analysis. Section 5 concludes the paper.

2 Industry Background

2.1 Card network

Payment cards were introduced in China in the 1980s, but they became common only in early 2000.[6] For transactions in the domestic currency, i.e., the RMB, China UnionPay is the monopoly card network in China. As in the case of the two major global card networks, Visa and MasterCard, the card network in China employs an open-loop network in which the card network is responsible for operating the network. For example, it runs marketing campaigns to develop the brand. However, the card network does not issue cards but rather lets member banks perform this task. The issuing bank provides card services and consumer credit for cardholders to earn membership fees and interest income. The acquirer performs several functions: 1) signing up (including providing POS equipment) and underwriting merchants to accept the card network; 2) providing methods to authorize valid card transactions from issuers at merchant locations; 3) bearing settlement risk by promising merchants that it will honor the payments authorized by cardholders; and 4) providing information services, such as sending out statements.

The card network charges a flat percentage merchant discount for each transaction, and the People's Bank of China (PBOC) and the National Development and Reform Commission (NDRC) regulate payment card pricing. There are three components of the merchant discount, namely, the interchange fee, network fee and acquirer fee, which are all flat fees. As shown in Figure 1, the issuing bank earns the interchange fee from merchants through the card network, the card network earns the network fee, and the acquirer earns the acquirer fee. Our focus is on the dashed rectangle in Figure 1, where the acquirer fee is determined by the acquirer and merchant.

[Insert Figure 1 here]

[6] See Appendix A for a brief discussion of industry developments until to the end of industry-specific regulations.

2.2 Fee regulation

As the left panel of Table 1 indicates, there have been four regimes of industry-specific regulation for the acquirer fee since the establishment of the card network in 2002.[7] In regime 1, the acquirer fee is the most restrictive in terms of an industry-specific fixed point. However, in regime 2, the regulation on the acquirer fee was removed, and it was instead determined via negotiation between the acquirer and merchant. This deregulation is explained below. As the growth of POS installations was substantially slower than the growth of cards in circulation over the period of regime 1 (see the right panel of Table 1), the deregulation of the acquirer fee was intended to provide incentives for acquirers to promote and install POS machines at merchants. Consistently, the growth of POS installations exceeded that of cards in circulation over the period of regime 2. In regime 3, the acquirer fee was partly regulated by allowing the acquirer to charge fees 10% above and below the benchmark acquirer fee. However, in regime 4, the acquirer fee was fully deregulated again and then determined through negotiations between acquirers and merchants.

[Insert Table 1 here]

Motivated by the historical pattern of regulations on acquirer fees, our aim is to explain how the acquirer fee was negotiated between acquirers and merchants in regime 2, when the use of POS was not prevalent. Furthermore, our empirical analysis can shed some light on situations in which industry-specific regulation tends to be effective.

3 Data and Descriptive Analysis

3.1 Data sources

Our empirical analysis is based on four datasets. First, we collect a unique merchant-level dataset on our sample province from the card network between March and December

[7] As mentioned in the introduction, interchange and network fees have been strictly regulated in China and declined over time (see Table A2 in the appendix). We provide the regulatory history of these two fees because we compute the acquirer fee as the merchant discount minus the interchange and network fees.

2004. The card network compiles the dataset by aggregating the card transaction data for each merchant. Our dataset contains the merchant ID, bank account ID, city ID, industry ID, total merchant fee to the card network, transaction volume with card and transaction values with card. Because the sample period falls into pricing regulation regime 2, there was no regulation of the acquirer fee. The acquirer negotiates with each merchant to determine the acquirer fee. The negotiated price is a flat acquirer fee, i.e., a fixed percentage of sales for each card transaction retained by the acquirer.[8]

Second, we utilize the industry ID of the merchant-level data to match these data with the industry statistics from the 2004 Economic Census of Guangdong Province, which provides industry-specific information on operating income and operating costs. Third, we collect the interchange and network fees for all industries from Document-126 released by the PBOC, which regulated those fees from March 2004 to February 2013. Fourth, we utilize the city ID in the merchant-level data to match these data with the city statistics from the 2005 Statistical Yearbook of Guangdong Province, which provides city-specific information on GDP per capita and demographic structure.

Overall, our sample includes 6,557 merchants operating in 72 industries and located in 20 cities of our sample province. Table 2 reports the descriptive statistics of our sample.

3.2 Acquirer fee and characteristics

Acquirer fee: For each merchant, we compute the merchant discount (denoted *Discount*) as the ratio of total merchant payments to the card network over the card transaction value. Because our sample period falls into regime 2 of payment card pricing regulation, we compute the acquirer fee (denoted *Fee*) as the difference between the merchant discount and the industry-specific interchange fee (denoted *IF*) and the network fee (denoted *NF*), where *IF* and *NF* were regulated and publicly disclosed (see Table A2 in the appendix). As shown in Table 2, the sample average of *Fee* is approximately 0.46% of the total card transaction value. The interquartile range indicates that the *Fee* mostly ranges between 0.2% and 1.2% of the total transaction value.

[Insert Table 2 here]

[8] No tiered pricing is used in our sample period because almost all cards are debit cards (see Appendix A).

Merchant: We construct three explanatory variables from the merchant-level data. We compute VPT as the ratio of card transaction value to the number of card transactions and TTV as the total card transaction value of a merchant. As shown in Table 2, the mean and median are RMB 0.70 and 0.34 thousand for VPT and RMB 294 and 42.2 thousand for TTV. The distributions of VPT and TTV are right skewed, which suggests that some consumers use cards for bulk purchases.

We use the bank account ID to construct a dummy variable to identify the type of bank at which merchants' bank accounts are held. SCB takes value 1 if the merchant has a bank account with one of the four largest the state commercial banks (SCBs) in China and 0 otherwise. The benchmark group is defined to contain merchants having a bank account with SCB=0 (corresponding to small banks, such as joint stock banks, city commercial banks and rural credit cooperatives). Table 2 reports that approximately 67% of merchants in our sample have their bank accounts associated with SCB=1. The high percentage of merchants having a bank account with SCBs is consistent with the large market share of SCBs in the deposit market (Dobson and Kashyap, 2006).[9]

Industry: Our sample merchants operate in 72 different industries (see Table A3 in Appendix B for the list of industries). We define *Margin* as the gross margin of the main business (=1-Operating Cost/Operating Income) at the industry level based on the data from the 2004 Economic Census of Guangdong Province. In Table 2, *Margin* indicates that the gross margin of our sample merchants is 28.9% on average.

We define *Penetrate* as the card penetration rate, the ratio of transaction values paid by card to operating income, i.e.,

$$Penetrate_j = \frac{\sum_{i=1}^{I_j} Transaction\ value\ by\ card\ payment_j}{Operating\ income_j}$$

where I_j is the total number of merchants in industry j. This variable is computed at the industry level; the numerator is calculated from the merchant-level data, and the denominator is collected from the Economic Census. On average, the penetration rate of card purchases is approximately 2.88% (see Table 2).

We define a dummy variable indicating whether a merchant operates in an industry with a higher fraud risk, *HFraud* (see Appendix C for the details of its construction).

[9]They document that the market share of SCBs in the deposit market in 2004 was approximately 60%.

HFraud indicates that 87% of our sample merchants belong to industries with a high fraud risk (see Table 2).

City: The sample merchants are located in 20 different cities (see Table A4 in Appendix B for the list of cities). Previous studies suggest that city-level characteristics may capture the heterogeneity in surplus for merchants located in different cities. Therefore, we construct three explanatory variables at the city level, namely, GDP per capita (*GDPPC*), ratio of non-agricultural population to total population (*NAPOP*), and ratio of net migrant to total population (*NMPOP*). In Table 2, the rows *GDPPC*, *NAPOP* and *NMPOP* report that the GDP per capita, the ratio of non-agricultural population to total population and the ratio of net migrants to total population have interquartile ranges between RMB 24 and 56 thousand, between 39% and 88% and between 0.66% and 1.53%, respectively.

3.3 Descriptive analysis

The substantial variations in those explanatory variables across merchants, industries and cities provide the information necessary to identify factors determining the acquirer fees across merchants. Because we are interested in the effects of those variables on the acquirer fee, it is useful to examine the characteristics of merchants charged different acquirer fee levels.

The right panel of Table 2 reports the characteristics of merchants charged an acquirer fee below the 40th percentile or above the 60th percentile.[10] First, the results indicate that merchants with a higher acquirer fee often have lower *VPT* and *TTV* and are less likely to use SCBs. Second, merchants with a higher acquirer fee tend to have higher *Margin* and *Penetrate* but are less likely to operate in an industry with a high fraud rate. Finally, merchants with a higher acquirer fee are often located in cities with higher *GDPPC*, higher *NAPOP* and higher *NMPOP*.

Table 3 reports the heterogeneity in *Fee* and merchant characteristics across groups. Table 3 classifies all industries into four groups depending on the levels of regulated interchange and network fees. Specifically, to provide an example of an industry included in each group, Table 3 reports the industry with the most observations in each group:

[10]Our results do not change qualitatively when we revise the lower threshold to the 25th percentile and the upper threshold to the 75th percentile. These results are available upon request.

recreational services for Group 1, clothing for Group 2, grocery stores and supermarkets for Group 3 and hospitals for Group 4.

[Insert Table 3 here]

Interestingly, there is substantial heterogeneity in acquirer fees across and within industries. The top panel reveals that merchants belonging to the catering and entertainment (Group 1) have the highest acquirer fee at 1.1% on average, which is followed by Group 2 at 0.7%. Then, Groups 3 and 4 have similar values of *Fee* at 0.4% and 0.5%, respectively. Turning to the within-group heterogeneity, the standard deviation of acquirer fees is 0.3%, 0.7%, 0.3% and 0.4% for Groups 1, 2, 3 and 4, respectively. The standard deviation is close to the average acquirer fees for Groups 2, 3 and 4. These findings indicate substantial variations in acquirer fees within groups, suggesting heterogeneous merchant-specific effects on acquirer fees. As the middle panel states, all of the above features are still present for the industry with the most observations in each of these four groups.

In the bottom panel, Groups 1 and 2 have a higher VPT but lower TTV than Groups 3 and 4. Once again, there is anecdotal evidence of a negative effect of TTV on *Fee*. Merchants in Groups 1 and 2 are operating in industries with higher *Margin*, *Penetrate* and *HFraud* and in cities with higher *GDPPC* and *NAPOP*. These results are consistent with those reported in Table 2.

4 Structural Analysis

The previous section establishes that merchant-, industry- and city-level factors play a role in determining the acquirer fee. In this section, we embed those forces into a model of Nash bargaining between the acquirer and merchant over the acquirer fee. Using the model estimates, we analyze the heterogeneous effect of merchant bargaining power on the acquirer fee. Furthermore, we investigate the importance of the merchant-specific surplus in the variation in the incremental surplus from card services relative to industry- and city-specific surpluses, which is of substantial policy relevance.

4.1 The model

The Nash bargaining solution, where players choose the price that maximizes the joint product of their individual surplus weighted by the player's bargaining power, is tractable in theory (Horn and Wolinsky, 1988; Collard-Wexler, Gowrisankaran, and Lee, 2019). It has been used in applied work to model bilateral negotiations in various business-to-business markets (e.g., Chipty and Snyder, 1999; Crawford and Yurukoglu, 2012; Grennan, 2013; Gowrisankaran, Nevo, and Town, 2015; Lakdawalla and Yin, 2015; Ho and Lee, 2017; An and Tang, 2019). As a surplus division rule, the Nash bargaining solution is suitable to model the acquirer fee determination in our data in which the acquirer and merchant negotiate to reach agreement on the acquirer fee.

In the Nash bargaining model, the acquirer fee maximizes the Nash product of merchant surplus and acquirer profit

$$\begin{aligned} Fee_{ijr} &= \underset{y\in\mathbb{R}_+}{argmax} \left[\left(p^c_{ijr} - y - IF_j - NF_j\right)TTV_{ijr} - p^d_{ijr}TTV_{ijr}\right]^{b_{ijr}} \left[TTV_{ijr}\left(y - Cost_{ijr}\right)\right]^{1-b_{ijr}} \\ &= \underset{y\in\mathbb{R}_+}{argmax} \left[\left(p^c_{ijr} - y - IF_j - NF_j\right) - p^d_{ijr}\right]^{b_{ijr}} \left[y - Cost_{ijr}\right]^{1-b_{ijr}} \end{aligned} \tag{1}$$

where Fee_{ijr} is the acquirer fee for merchant i's usage of card services in industry j and city r, p^c_{ijr} and p^d_{ijr} are the merchant's per unit profit with payment card usage and without payment card usage, respectively, and we use the total transaction volume TTV_{ijr} to represent the consumer demand because the three fees of card usage are determined in terms of the proportion of total transaction volume. Note that in (1) we implicitly assume that consumer demand represented by TTV_{ijr} is not affected by whether the payment is made by cash or by card, which seems plausible because it is the merchant who pays the card usage fees. In addition, $Cost_{ijr}$ is the acquirer cost of providing acquirer services. For the acquirer's cost, we use a parsimonious form by specifying $Cost_{ijr} = Cost$ for any merchant i in industry j and city r, where the constant $Cost$ represents the average cost of acquirer to provide card services.

The variables $b_{ijr} \in (0,1)$ and $1 - b_{ijr} \in (0,1)$ represent the bargaining power of the merchant and acquirer, respectively. In recent empirical research in bargaining settings, bargaining power can represent concepts such as a party's negotiation skill or experience.[11] Note that in Equation (1), the merchant surplus with card services

[11] Bargaining power is represented by a player's patience in the theoretical literature (e.g., Rubinstein,

$s_{ijr} = \left(p^c_{ijr} - y - IF_j - NF_j\right) TTV_{ijr}$ is implicitly assumed to be larger than his refusal payoff without the card services $d_{ijr} = p^d_{ijr} TTV_{ijr}$. This can arise from a higher sales revenue by attracting more consumers, relaxing consumers' willingness to spend and competing more effectively with other merchants.[12]

The first-order condition in (1) implies that the acquirer fee is given by

$$\begin{aligned} Fee_{ijr} &= b_{ijr} Cost + (1 - b_{ijr})(p^c_{ijr} - p^d_{ijr} - IF_j - NF_j) \\ &= b_{ijr} Cost + (1 - b_{ijr})(p_{ijr} - IF_j - NF_j) \\ &= Cost + (1 - b_{ijr})(p_{ijr} - IF_j - NF_j - Cost), \end{aligned} \tag{2}$$

where $p_{ijr} = p^c_{ijr} - p^d_{ijr}$ is the merchant's incremental surplus from card services. Therefore, the acquirer fee is equal to the cost plus a margin that is the acquirer's bargaining power $(1 - b_{ijr})$ multiplied by the net incremental surplus $(p_{ijr} - IF_j - NF_j - Cost)$ from card services. In the empirical analysis, we employ the following parametric specifications for the merchant's incremental surplus p_{ijr} and bargaining power b_{ijr}

$$p_{ijr} = (Margin_j + \beta_1 Penetrate_j + \beta_{Group}) + \beta_r + \varepsilon_i \tag{3}$$

$$b_{ijr} = \frac{exp(\beta_{21} \ln(VPT_{ijr}) + \beta_{22} \ln(TTV_{ijr}) + \beta_{23} \ln(SCB_{ijr}))}{1 + exp(\beta_{21} \ln(VPT_{ijr}) + \beta_{22} \ln(TTV_{ijr}) + \beta_{23} \ln(SCB_{ijr}))}, \tag{4}$$

Heterogeneous incremental surplus: Equation (3) The merchant's incremental surplus from card services p_{ijr} depends on industry-, city- and (unobserved) merchant-specific characteristics. First, the variable *Margin* defined above matters because we expect that merchants in industries with higher profitability receive a larger incremental surplus from accepting card services. We expect that the card network charges a higher acquirer fee to merchants with a higher *Margin*. Moreover, the coefficient on *Margin* is set to be one, which implies that merchant's incremental surplus p_{ijr} can be measured in terms of the unit of *Margin*. This implication is consistent with our specification (1).

1982). In many recent models in empirical works, bargaining power is interpreted as capturing the share of the surplus that the player would receive in a Nash bargaining game (e.g., Binmore, Rubinstein, and Wolinsky, 1986).

[12] There is anecdotal and empirical evidence that accepting cards can increase merchant revenue and consumer spending, such as https://www.vantiv.com/merchant-services/credit-card-merchants-higher-revenue and Finkelstein (2009). In the theoretical literature, Rysman and Wright (2014) review the arguments on how merchants attract more consumers by accepting cards.

For simplicity let $p_{ijr} = Margin_j$, Then, the product Margin × TTV is related to the merchant total surplus in (1) because roughly speaking, this product can be interpreted as the merchant total profit.[13]

Second, we allow the incremental surplus from card services to rely on the card penetration rate. When consumers are more likely to use cards for purchases, merchants become more willing to accept card services to compete for consumers (Rochet and Tirole, 2002).[14] We expect that, on the one hand, merchants receive less benefit from card services as card usage becomes more widespread among competing merchants. On the other hand, merchants benefit more from card services as more consumers pay with cards. Hence, there are mixed impacts of the card penetration rate on the acquirer fee.

Third, we include group-level FEs because the observed industry characteristics may not fully explain the variations in *Fee* across groups. In particular, Table 3 reports that Groups 1 and 2 have higher acquirer fees than Groups 3 and 4. Therefore, we include FEs for Groups 1 and 2, i.e., $\beta_{Group} = \beta_{g1}\mathbb{1}\{\text{Group 1}\} + \beta_{g2}\mathbb{1}\{\text{Group 2}\}$, in some of our specifications.

In addition, although the city-level characteristics may capture consumers' card usage, those variables can also capture the effects of consumer demand and market competition.[15] As a result, it is difficult to disentangle the effects of city-level characteristics in our empirical model. Furthermore, the inclusion of few city-level characteristics may omit the influence of other city characteristics on the acquirer fee. In our empirical specification, we include city-level FEs (β_r) instead of city-level characteristics to avoid ambiguity in interpreting city-level variables and to better control for the influence of city characteristics on the acquirer fee.

[13]For example, Margin × TTV = $\frac{\text{price - merchant marginal cost}}{\text{price}}$ × price × quantity = merchant total profit, where TTV is the product of selling price and quantity sold.

[14]This argument is supported by empirical evidence from the payment card industry. Rysman (2007) finds a positive correlation between consumer card usage and merchant acceptance, which demonstrates the effect of a two-sided market in the payment card industry. Valverde, Chakravorti, and Fernández (2016) find positive feedback loop effects between card issuance and POS machines installed at the bank level in the Spanish payment card market.

[15]For example, merchants in cities with higher GDP per capita, a higher ratio of non-agricultural population to total population and a higher ratio of net migrants to total population are more likely to face wealthier, more educated and younger consumers who are more willing to use cards for purchases (see Zhao, 1999 for age effects on migration in China and Borzekowski, Elizabeth, and Shaista (2008) for how consumer demographics affect card usage).

Heterogeneous merchant bargaining power: Equation (4) The bargaining power of the merchant is allowed to vary with merchant's observed characteristics. First, we include value per transaction (VPT) because consumers buying from merchants with a higher value per transaction are more likely to use cards (Klee, 2008; Cohen and Rysman, 2013). For example, consumers are more likely to use cards to pay their jewelry bills because the transaction prices of such purchases can be high. Cards are a better payment method than cash for large expenditure sizes because consumers may find it unsafe and costly to find an ATM to withdraw cash for such purchases when a jeweler refuses to accept card payments. As a result, jewelers compete with one another by accepting card payments to attract consumers. We expect that the acquirer has greater bargaining power against merchants when facing consumers with a larger expenditure size.

Second, we use merchants' total transaction value (TTV) with cards to capture the effect of merchant size on bargaining power. Kjos (2007) argues that merchant acquisition is data-intensive and exhibits scale economies. Kjos (2007) and Bounie, François, and Van Hove (2017) report that in the U.S. and France, merchants with higher sales revenue are more likely to be charged a lower merchant discount. Hence, we expect that the acquirer has weaker bargaining power against larger merchants.

Third, SCBs may charge a higher fee for their services than smaller banks, in particular for transferring merchants' card receipts from the acquirer to their bank accounts. The acquirer may demand a higher acquirer fee for merchants who hold bank accounts with SCBs. We expect that the acquirer has greater bargaining power against merchants using SCBs.

4.2 Estimation

We rearrange Equation (2) to estimate how industry-level factors affect the incremental surplus from card services and how merchants' characteristics affect their bargaining power.

$$\frac{Fee_{ijr} - b_{ijr}Cost}{1 - b_{ijr}} + IF_j + NF_j - Margin_j - \beta_1 Penetrate_j - \beta_{Group} - \beta_r = \varepsilon_i. \quad (5)$$

Under the assumption $\mathbb{E}(\varepsilon_i|Z) = 0$ with a set of exogenous variables Z, we use the method of moments to estimate the parameters in (5).

Moreover, TTV with cards may be subject to endogeneity due to reverse causality and omitted variable bias, which may induce upward bias in the relationship between *Fee* and TTV with cards. For example, merchants experiencing a positive demand shock in card purchases may be willing to accept a higher acquirer fee. Furthermore, merchants that completely rely on card purchases, on the one hand, encourage consumers to make purchases with cards and, on the other hand, increase the card network's pricing power because cash is not an outside option for merchants. These sources of endogeneity can bias the estimates of bargaining power.

Therefore, we propose the average value of TTV with cards of other merchants in the same industry and city as the IV for the potentially endogenous TTV with cards. First, we expect a positive relationship between IV and TTV with cards because all merchants in the same industry and city share common consumers. If consumers in a city are more likely to use cards for purchasing goods and services from an industry, their preferences regarding card usage affect all merchants in the same industry and city. Second, we expect that when the acquirer prices its fee for a merchant, the fee depends solely on that merchant's willingness to pay for the payment services, which depends on the TTV with cards of that merchant but not the TTV with cards of other merchants in the same industry and city. This, in turn, provides the exclusion restriction for our IV in estimating Equation (5).

Finally, to estimate *Cost*, we construct a moment condition with a dummy variable indicating whether merchants in industries bear a higher fraud risk, *HFraud*. The acquirer's cost depends on the likelihood that the payment is authorized by an authentic cardholder because the acquirer needs to honor fraudulent payments to merchants if due diligence is exercised. The acquirer's profit from providing card services is lower for industries that are more likely to receive fraudulent payments to cover its potential monetary loss for honoring them. We expect that *HFraud* provides information to estimate the acquirer's cost because the acquirer's cost is higher for industries that are more likely to receive fraudulent payments.

4.3 Empirical results

We report the empirical results of Equation (5) in Table 4. Columns 1-2 report the results of the OLS estimation, and Column 2 also includes group FEs. The inclusion of group FEs

usually results in more precise coefficient estimates. Columns 3-4 report the IV estimation results to address the potential endogeneity of TTV. Because Column 4 addresses various econometric issues, we focus our discussion on that specification.

[Insert Table 4 here]

Regarding the industry-level effect on the acquirer fee, the coefficient on *Penetrate* is negative and significant at the 1% level. In particular, when the value of *Penetrate* increases from the 25th percentile to the 50th percentile (i.e., 1.73%), the acquirer fee decreases by 0.08% on average according to the following marginal effects expression

$$\frac{\partial Fee_{ijr}}{\partial Penetrate_j} = \beta_1(1 - b_{ijr})$$

This result suggests that the average merchant profit from using card services is higher in industries with a lower penetration rate of card purchases.

In addition, our specification of bargaining power allows us to identify firm-specific differences in bargaining power. The coefficient on $\ln(TTV)$ is positive and significant at the 1% level. This result suggests that the acquirer has weaker bargaining power against merchants that accept a larger volume of card purchases. When the value of TTV increases from the 25th percentile to the 50th percentile (i.e., 27.7 thousand), the acquirer fee decreases by 0.27% on average according to the following marginal effects expression implied by Equation (2)

$$\frac{\partial Fee_{ijr}}{\partial TTV_{ijr}} = \frac{1}{TTV_{ijr}} \frac{\partial Fee_{ijr}}{\partial \ln(TTV_{ijr})} = -\frac{\beta_{22}}{TTV_{ijr}} b_{ijr}(1 - b_{ijr})(p_{ijr} - IF_j - NF_j - Cost)$$

Analogously, if the value of VPT increases from the 25th percentile to the 50th percentile (i.e., 0.19 thousand), the acquirer fee increases by 0.04% on average. However, SCB is insignificant, suggesting little evidence for the effect of SCB on merchant bargaining power and hence the acquirer fee.

Turning to the acquirer's cost, the coefficient of *Cost* is 0.003 and significant, which suggests that the acquirer's cost for providing acquisition services is 0.3% of transaction value. According to the cost estimate of providing acquisition services for debit cards from previous studies, Board of Governors of the Federal Reserve System (2011) and

Reserve Bank of Australia (2014) report that the cost of PIN debit card usage is 0.3% of the transaction value. Consistently, because most of the cards in circulation in our sample are debit cards (see Appendix A), our cost estimate is reasonable. In addition, the estimated cost is higher than the regulated acquirer fee in regime 1, which suggests that the sluggish growth of POS machine installation might be driven by the lack of profit for acquirers.

4.4 Bargaining power

In this subsection, we consider the estimate of bargaining power. Greater variation in bargaining power across merchants suggests that the relative bargaining power between the acquirer and merchant is an important source of fee variation. The model implies that the bargaining power of acquirer $1 - b_{ijr}$ is given by

$$1 - b_{ijr} = \frac{1}{1 + exp(\beta_{21}\ln(VPT_{ijr}) + \beta_{22}\ln(TTV_{ijr}) + \beta_{23}\ln(SCB_{ijr}))}.$$

Using the parameter estimates, we obtain the estimate for the acquirer's bargaining power. In the upper panel of Table 5, the average bargaining power of acquirers is approximately 0.05 for the full sample, implying that acquirers have considerably less bargaining power than do merchants, at approximately 0.95. Moreover, this result implies that the division of surplus from card services for the acquirer relative to the merchant is approximately 1:20, which suggests that the card network concedes the majority of the surplus to merchants. This result seems odd at first sight, as the sample province had a monopoly acquirer during the sample period. As the growth of POS machine installation had been slow until our sample year (see the right panel of Table 1), such a pricing strategy by the acquirer is consistent with the use of a low price to encourage merchants to use card services and in turn expand the coverage of POS machines.

[Insert Table 5 here]

Additionally, there is mild heterogeneity in the acquirer's bargaining power, with the majority ranging from 0.015 to 0.108. Furthermore, although the average bargaining power of the acquirer is relatively low for merchants belonging to catering and entertainment (Group 1), at 0.043, the acquirer fee for catering and entertainment is the highest

in Table 3. Therefore, the higher acquirer fee for those merchants is driven by the incremental surplus from card services, thus suggesting that the acquirer relies more on the low-price strategy to induce merchants enjoying a higher surplus from card services to use cards. This result implies that the acquirer leaves more surplus to merchants and provides higher powered incentives for merchants to use card services.

Although the acquirer's bargaining power is weak, it may still have important economic effects on merchants because the bargaining power interacts with the net incremental surplus from card services to affect the acquirer fee (Equation 2). Particularly, among the three variables with significant coefficients in Table 3, TTV has the strongest impact on the acquirer fee. Our results suggest that merchants with a larger amount of card transactions enjoy greater bargaining power vis-à-vis the acquirer than do smaller merchants. One concern related to asymmetric bargaining power between larger and small merchants is that such price discrimination may disadvantage small merchants competing against large ones, such as chain stores.

Moreover, in the middle panel of Table 5, we compute the counterfactual acquirer fees for our sample merchants by setting all variables in Equation (2) at their mean values except for $\ln(TTV)$. The interquartile range of counterfactual acquirer fees for the full sample is 0.6% of the transaction value, which is approximately 2% of the gross margin. Furthermore, the interquartile ranges of counterfactual acquirer fees are 0.9%, 0.6%, 0.2% and 0.4% for Groups 1, 2, 3 and 4, respectively. They range between 1 and 2% of the gross margin for those four groups. As a result, price discrimination across merchants driven by their bargaining power provides a cost advantage to larger merchants over their smaller competitors.

4.5 Variance decomposition

In this subsection, we perform variance decomposition on the incremental surplus from card services p_{ijr} to provide relevant implications for the regulation of acquirer fees. As Equation (3) implies, the incremental surplus p_{ijr} characterizes the sources of merchants' willingness to pay for card services, and it is composed of three components: an industry-specific surplus (i.e., $Margin_j + \beta_1 Penetrate_j + \beta_{Group}$), a city-specific surplus (i.e., β_r) and a merchant-specific surplus (i.e., ε_i). Therefore, whether an industry-specific regulation on acquirer fees is effective depends mainly on the relative variations among industry-specific,

city-specific and merchant-specific surpluses.

Because the bargaining power in fee negotiation serves to divide the net incremental surplus between acquirer and merchant, a regulation on acquirer fees, if imposed, would replace the bargaining power is the means of dividing the surplus. If the city-specific and merchant-specific surpluses dominate the industry-specific surplus in terms of the variation in incremental surplus, imposing regulation on the basis of the industry levels may not be effective in allocating card services. This is because a high regulated fee may exceed the willingness to pay for card services for some merchants with low incremental surplus, while a low regulated fee may not compensate for the acquirer's cost of serving merchants.

Accordingly, we decompose the total variance of p_{ijr} into the above three components of variation: an industry-specific surplus, a city-specific surplus and a merchant-specific surplus. The challenge of this analysis is that p_{ijr} is unobserved; thus, we obtain its estimate from our structural estimation. We use the variance decomposition methods to disentangle and compare the sources of variance of p_{ijr}:

$$\begin{aligned} \text{Var}(p_{ijr}) &= \text{Var}(\textit{Industry-Specific Surplus}) + \text{Var}(\textit{City-Specific Surplus}) \\ &+ \text{Var}(\textit{Merchant-Specific Surplus}) + \text{Covariance terms}, \end{aligned} \tag{6}$$

where

$$\begin{aligned} \textit{Industry-Specific Surplus} &= \textit{Margin}_j + \beta_1 \textit{Penetrate}_j + \beta_{\textit{Group}} \\ \textit{City-Specific Surplus} &= \beta_r \\ \textit{Merchant-Specific Surplus} &= \varepsilon_i \end{aligned}$$

If all of the covariance terms in (6) were zero, the relative importance of the different components would be determined by their respective variances. However, these components are typically correlated; it does not appear straightforward to decompose the model R^2 (coefficient of determination) in Equation 2 into shares from each of these components. Therefore, we use two relevant variance decomposition methods to compute the relative importance of each of these three components of $\text{Var}(p_{ijr})$. First, Lindeman, Merenda, and Gold (1980) (henceforth LMG) propose the sequential sums of R^2 from the linear model—the size of which depends on the order of the regressors in the model—and ob-

tain the relative importance of each individual regressor by averaging over all orderings of regressors. Second, Feldman (2005) introduces the proportional marginal variance decomposition method (henceforth PMVD). The computational details of those two methods for our model are outlined in Appendix D. As reported in the lower panel of Table 5, the decomposition results for these two methods are similar because PMVD is a weighted analog of LMG with data-dependent weights.

Our results indicate that the variance of unobserved merchant-specific surplus ε_i has the largest contribution to $\text{Var}(p_{ijr})$ for Groups 1, 3 and 4. This pattern is common in cross-sectional studies, in which unobservable factors explain a large part of variation. For Group 2, the variances of both merchant- and industry-specific surplus have the largest contributions, which is also true for the full sample because Group 2 represents a much larger proportion of our data than the other three groups. Specifically, for the full sample, the contributions of merchant-specific surplus, industry-level surplus and city-specific surplus are 46%, 46% and 8% to $\text{Var}(p)$ according to the LMG and PMVD methods, respectively. Overall, the merchant-specific surplus plays a significant role in determining $\text{Var}(p_{ijr})$ across merchants, which suggests that merchants have a wide range of willingness to pay for using card services, and hence, an industry-specific regulation on acquirer fees may not efficiently promote the usage of card services.

5 Conclusion

This paper examines the pricing of acquirer fees. The empirical context is particularly appropriate for our objective because our unique dataset allows us to compute the acquirer fee paid by each merchant. We analyze this dataset with a tractable bargaining model between the acquirer and merchant, who divide the surplus from card services by setting the acquirer fee. We estimate the model and then analyze the bargaining power of the acquirer against merchants and the variation in the incremental surplus from card services across merchants.

Our empirical findings are as follows. First, we find that the industry-specific surplus from card services depends on the card penetration rate and that the acquirer's cost is non-trivial. Furthermore, our results are robust to the inclusion of group-level FEs, city-level FEs and the use of IV estimation. Second, utilizing the estimates of the structural

model, we compute the bargaining power of the acquirer. We find that the bargaining power of the acquirer is weaker than that of merchants and that merchants with a lower value per transaction and a larger total transaction value have greater bargaining power. Finally, we find that the merchant-specific surplus is a main source of the variation in incremental surplus from card services across merchants.

Although our sample period was characterized by no regulation on the acquirer fee, there were brief periods with industry-specific regulations, i.e., regimes 1 and 3 (see the left panel of Table 1). The regulation of acquirer fees in regime 1 eliminates the variation in acquirer fees across merchants within the same group, and that in regime 3 restricts the variation in acquirer fees across merchants belonging to the same group to be within 10% (above or below) of the benchmark fee. Therefore, our results suggest that industry-specific regulations on acquirer fees do not efficiently allocate card services across merchants. In other words, industry-specific regulation of acquirer fees would be ill-suited because the variation in acquirer fees was also driven strongly by the merchant-specific surplus. Furthermore, these results lend support to the resumption of the full deregulation of acquirer fees in the current regime, i.e., regime 4 (see the left panel of Table 1). However, our analysis also shows that there is a qualification for interpreting this policy implication. If the acquirer fee is completely determined through bilateral negotiation between merchant and acquirer, as the empirical results suggest, large-sized merchants have greater bargaining power and hence pay a lower acquirer fee than small-sized merchants. Such price discrimination may disadvantage small retailers competing against large ones and violate the spirit of laws concerning protecting competition, especially in the intermediate goods market. Therefore, regulation should ideally address the trade-off among these competing factors. One potential topic for future research relates to the dynamic pricing of acquirer fees. Because our current research is based on a cross-sectional dataset, there remains the question of whether the acquirer increases acquirer fees in the future to compensate for the low prices used for developing merchants' habits in the early period of card usage. Researchers may wish to document the existence of such intertemporal pricing and identify the conditions under which the acquirer gains more from such pricing. Another future research direction is to extend our model to analyze markets with multiple acquirers, such as the U.S., where the top-10 firms had approximately 70% market share in 2011 (Capgemini (2012)). Researchers could use a simultaneous bilateral Nash

bargaining approach in the spirit of Ho and Lee (2017) to model the negotiated acquirer fee by capturing the potential competition among acquirers. Such an extension would allow an analysis of mergers, such as Fiserv-First Data and FIS-Worldpay, on negotiated acquirer fees.[16]

[16] Wall Street Journal "Paying Up for Worldpay Might Make Sense", March 18, 2019.

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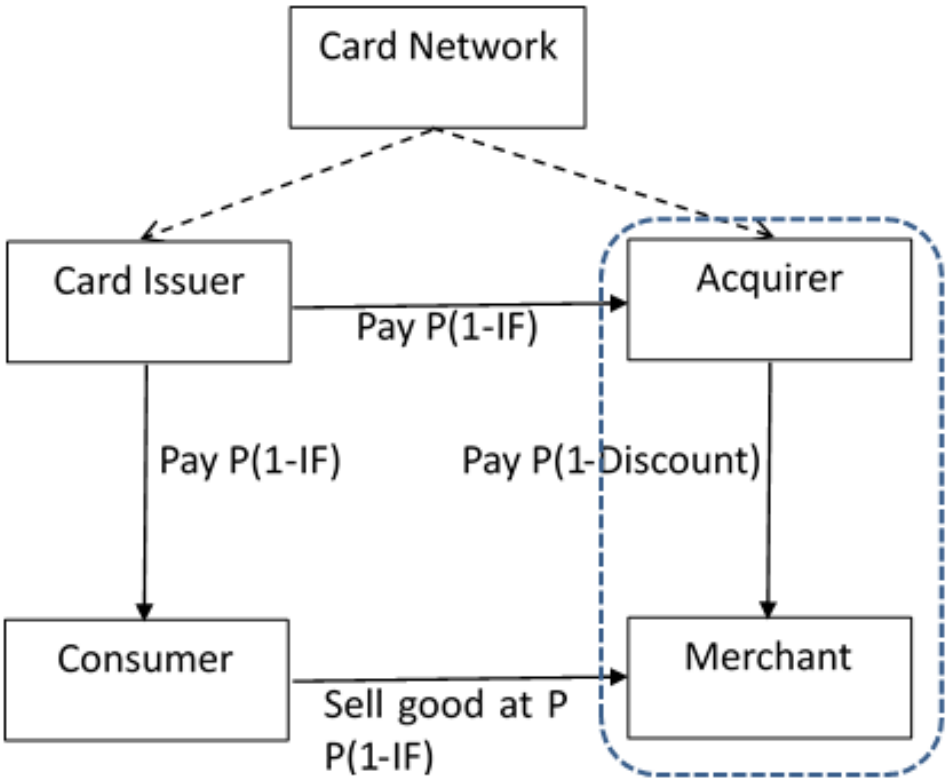
Figures

Figure 1: Card Network in Guangdong Province



Note: Merchant discount (Discount) = Interchange fee (IF) + Network fee + Acquirer fee.

Tables

Table 1: Industry Background

	Panel A: Regulation of Acquirer Fee				Panel B: Industry Development			
Regime	Group 1 Catering & Entertainment	Group 2 Standard	Group 3 Well-being	Group 4 Non-profit		POS Installed	Card in Circulation	Card Purchase Value
1: Mar. 2002-Feb. 2004	0.2	0.1	0.1	0.1	2002	0.29	0.50	0.19
2: Mar. 2004-Feb. 2013	Flexible	Flexible	Flexible	Flexible	2004	0.35	0.79	0.60
3: Mar. 2013-Aug. 2016	0.22 $\pm$ 10%	0.15 $\pm$ 10%	0.08 $\pm$ 10%	At Cost	2013	10.6	4.21	31.8
4: Sep. 2016-Present	Flexible	Flexible	Flexible	Flexible	2016	24.5	6.13	56.5

Unit: Panel A - %. Panel B - Million for POS installed, Billion for card in circulation and RMB trillion for card purchase value. Note: Group 1: Hotels, restaurants, entertainment, jewelry and arts and crafts. Group 2: Most industries that do not fall into the other three categories. Group 3: Transportation, supermarkets and gas stations. Group 4: Public education and hospitals. Exception: Travel agency was classified into Group 1 in Regime 1, but into Group 2 in Regime 2-3. Real estate and automobile were classified into Group 2 in Regime 1-2, but into Group 1 in Regime 3.

Sources for Panel A: Regime 1 follows the Document-17 released by the PBOC in January 1999. Regime 2 follows the Document-126 approved by the PBOC in March 2004. Regime 3 follows the Document-236 released by the PBOC in November 2012 and the Document-66 released by the NDRC in January 2013. The regulation was enacted in February 25, 2013. Regime 4 follows the Document-557 released jointly by the PBOC and the NDRC in March 2016. The regulation went into effective on September 6, 2016. Sources for Panel B: Almanac of China Finance and Banking for 2002 and 2004. Report on the Development of Chinas Bankcard Industry, China Payment System Development Report and the Overall Situation of China Payment System for years 2013 and 2016.

Table 2: Descriptive Statistics

	Unit	Mean	SD	P(25)	P(50)	P(75)	Fee ≥ P(60)	Fee ≤ P(40)	Difference
Prices									
Discount	%	1.41	0.70	1.00	2.00	2.00	2.14	0.94	1.20***
Fee	%	0.46	0.71	0.20	0.20	1.20	1.34	0.18	1.16***
Merchant Characteristics									
VPT	¥ 1k	0.70	1.06	0.15	0.34	0.81	0.67	0.95	-0.29**
TTV	¥ 1k	294	2228	14.5	42.2	132	116	440	-325***
SCB	Binary	0.67	0.47	0	1	1	0.66	0.72	-0.06***
Industry Characteristics									
Margin	%	28.9	16.6	17.5	24.5	36.0	38.5	23.9	14.6***
Penetrate	%	2.88	1.61	1.67	3.40	3.74	3.17	2.77	0.40***
HFraud	Binary	0.87	0.33	1	1	1	0.89	0.91	-0.02***
City Characteristics									
GDPPC	¥ 1k	43.6	19.2	23.6	47.7	56.3	47.1	40.7	6.49***
NAPOP	%	72.1	27.3	39.0	88.4	88.4	74.0	72.1	1.88**
NMPOP	%	1.21	1.06	0.66	1.50	1.53	1.28	1.12	0.16***

Abbreviation: Discount is merchant discount; Fee is merchant fee; VPT is value per transaction; TTV is total transaction value; ¥ 1k denotes RMB 1000; SCB is state commercial bank; Margin is gross margin; HFraud is a dummy variable of high fraud risks; GDPPC is GDP per capita; NAPOP is ratio of non-agricultural population to total population; NMPOP is ratio of net migrant to total population.

Data source for the variables at merchant level: The card network in China. Data sources for the variables at the industry-level: Margin are collected from the Economic Census 2004 of Guangdong province, Penetrate are collected from the Economic Census and the card network in China, and HFraud are collected from the card network in China. Data source for the variables at city level: The Statistical Yearbook of Guangdong 2005. Number of observations are 6,557. Number of observations are 2,623 for the subsample with Fee P(60) and Fee P(40), respectively. *** Significant at the 1% level, ** significant at the 5% level, * significant at the 10% level.

Table 3: Descriptive Statistics across Groups

	Unit	Group 1 Catering & Entertainment	Group 2 Standard	Group 3 Well-being	Group 4 Non-profit
Fee	%	1.1	0.7	0.4	0.5
		(0.3)	(0.7)	(0.3)	(0.4)
Observations		100	5,531	715	211
Industry with the Largest Observations		Recreational services	Clothing	Grocery store & supermarket	Hospital
Fee	%	1.2	0.8	0.5	0.5
		(0.3)	(0.5)	(0.3)	(0.4)
Observations		71	1,713	527	209
Merchant Characteristics					
VPT	¥ 1k	0.84	0.71	0.57	0.82
TTV	¥ 1k	245	249	549	643
SCB	Binary	0.66	0.68	0.71	0.56
Industry Characteristics					
Margin	%	54.3	29.8	19.0	25.3
Penetrate	%	6.68	2.89	1.33	5.98
HFraud	Binary	1	0.90	0.92	0
City Characteristics					
GDPPC	¥ 1k	50.9	43.4	42.8	46.7
NAPOP	%	79.9	72.4	66.3	79.0
NMPOP	%	1.28	1.20	1.11	1.74
Observations		100	5,531	715	211

Table reports each variable's mean with its standard deviation in parenthesis. Abbreviation: Discount is merchant discount; Fee is merchant fee; VPT is value per transaction; TTV is total transaction value; ¥ 1k denotes RMB 1000; SCB is state commercial bank; Margin is gross margin; HFraud is a dummy variable of high fraud risks; GDPPC is GDP per capita; NAPOP is ratio of non-agricultural population to total population; NMPOP is ratio of net migrant to total population.

Data source for the variables at merchant level: The card network in China. Data sources for the variables at the industry-level: Margin are collected from the Economic Census 2004 of Guangdong province, Penetrate are collected from the Economic Census and the card network in China, and HFraud are collected from the card network in China. Data source for the variables at city level: The Statistical Yearbook of Guangdong 2005.

Table 4: Structural Estimation of Bargaining Model

	(1)	(2)	(3)	(4)
Industry-Specific Surplus				
Penetrate	-1.024***	-0.978***	-0.949***	-0.978***
	(0.226)	(0.196)	(0.294)	(0.182)
Group FE	No	Yes	No	Yes
City-Specific Surplus				
City FE	Yes	Yes	Yes	Yes
Bargaining				
ln(VPT)	-0.479	-0.374	-0.279***	-0.230*
	(0.424)	(0.290)	(0.088)	(0.126)
ln(TTV)	0.560**	0.500***	0.474***	0.428**
	(0.229)	(0.152)	(0.074)	(0.078)
SCB	0.061	0.072	-0.069	-0.007
	(0.121)	(0.107)	(0.097)	(0.091)
Acquirer's Cost				
Cost	0.004***	0.004***	0.002*	0.003***
	(0.001)	(0.000)	(0.001)	(0.001)
IV estimation	No	No	Yes	Yes
Observations	6,557	6,557	6,557	6,557

Note: IV Estimation uses the logarithm of average value of TTV with card of other merchants in the same industry and city as the instrumental variable for ln(TTV). Standard errors are presented in parentheses below the coefficient estimates. *** Significant at the 1% level, ** significant at the 5% level, * significant at the 10% level.

Table 5: Bargaining Power and Sources of Variation

	Group 1	Group 2	Group 3	Group 4	All
Bargaining Power of Acquirer					
Mean	0.043	0.056	0.038	0.045	0.054
(SD)	(0.021)	(0.029)	(0.026)	(0.028)	(0.029)
P(5)	0.019	0.017	0.008	0.011	0.015
P(25)	0.028	0.035	0.019	0.024	0.032
P(50)	0.036	0.052	0.033	0.039	0.049
P(75)	0.055	0.072	0.050	0.056	0.070
P(95)	0.094	0.110	0.131	0.107	0.108
Counterfactual Fee					
P(5)	0.009	0.005	0.004	0.004	0.005
P(25)	0.013	0.008	0.005	0.005	0.007
P(75)	0.022	0.014	0.007	0.009	0.013
P(95)	0.036	0.022	0.011	0.015	0.021
Variance Decomposition					
Var(p_{ijr})	0.027	0.035	0.025	0.009	0.035
Method LMG					
Industry-Specific Surplus	0.005	0.017	0.008	0.000	0.016
City-Specific Surplus	0.001	0.003	0.001	0.001	0.002
Merchant-Specific Surplus	0.021	0.016	0.016	0.008	0.016
Method PMVD					
Industry-Specific Surplus	0.007	0.017	0.009	0.000	0.016
City-Specific Surplus	0.001	0.002	0.001	0.001	0.002
Merchant-Specific Surplus	0.019	0.016	0.014	0.008	0.016
Observations	100	5,531	715	211	6,557

Note: The figures are computed with the results reported in Column 4 of Table 4. Bargaining power of acquirer $= 1/\left(1 + exp\left(\beta_{31}\ln(VPT_{ijr}) + \beta_{32}\ln(TTV_{ijr}) + \beta_{33}\ln(SCB_{ijr})\right)\right.$. The counterfactual fees are computed with sample values of TTV and sample means of all other variables.

Appendix

A Development of Payment Card Industry

Payment cards were introduced in China in the 1980s. The state commercial banks (SCBs), i.e., the four largest banks, issued their first payment cards beginning in 1985. More specifically, BOC, ICBC, CCB and ABC issued their first payment cards in 1985, 1987, 1990 and 1991, respectively. The joint stock banks (JSBs) began issuing payment cards in the 1990s. The payment card industry has grown rapidly since then, especially after the establishment of China UnionPay in March 2002 with over 80 financial institutions as shareholders.

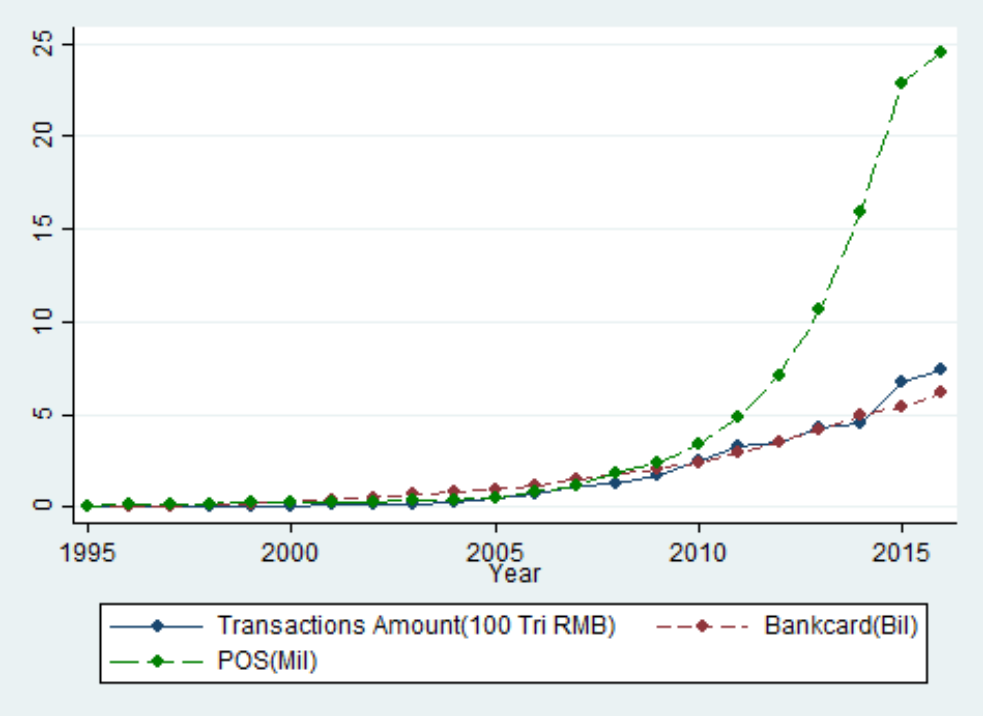
Figure A shows that the number of POS machines installed, the number of cards in circulation and card transaction values grew by 506, 437 and 771 times, respectively, over the period 1995-2016. Further, the share of debt cards (without overdraft facilities) to total payment cards was always larger than 90% since 1995. In particular, the corresponding figure in our sample year 2004 was 95.9%.

To put the descriptive statistics in a comparative context, we report the basic information for the payment card industries in China and Europe in Table A1. In 2006, the number of cards per capita and the fraction of GDP paid by card in China were 0.86 and 6.01%, respectively. In Europe, the number of cards per capita and the fraction of GDP paid by card were 1.29 and 12.94%, respectively. In 2010, the number of cards per capita in China (1.80) exceeded that in Europe (1.45), and the fraction of GDP paid by card in China (13.74%) approached the figure for Europe (14.52%). Further, merchant acceptance in China was low (relative to European countries) in 2005. The rate of POS machine installation per 1,000 people in China was only 0.39 in 2005. In Europe, for example, the rate of POS terminals per 1,000 people ranged from 2.7 in Bulgaria to 45 in Luxembourg and Bulgaria in 2005.[17]

Finally, to put the payment card pricing in China into context, we compare the merchant discount of our sample (i.e. Guangdong province in year 2004) with those for the U.S., Canada and Europe. The average merchant discount in our sample is about 1.4%

[17]Data source for China: See the note of Figure 1. Data source for Europe: Payment and securities settlement systems in the European Union (known as the Blue Book) published by the ECB in August 2007.

Figure A: Development of Payment Card Industry in China



Source: Almanac of China Finance and Banking for years 1995-2006. Report on the Development of Chinas Bankcard Industry, China Payment System Development Report and the Overall Situation of China Payment System for years 2006-2016.

Table A1: Payment Card Industries in China and Europe in 2006 and 2010

	China		Europe	
	2006	2010	2006	2010
Card holding per capita	0.86	1.8	1.29	1.45
Percentage of card purchase to GDP	6.01%	13.74%	12.94%	14.52%

Data source for China: See Figure 1.
Data source for Europe: Card holding and card purchase information come from ECB Payment Statistics 2011; population and GDP data are from Eurostat.
Note: Transaction value includes deposits, withdrawals, transfers and purchases. Exchange rate CNY/Euro $\approx$ 10 in 2005. Payment card include debit and credit cards.

of transaction value with card.[18] For the U.S., Hayashi (2009) finds that the average merchant discount for accepting signature debit cards and credit cards is 1.8-2.4% of the transaction value, and that for accepting debit cards is approximately 0.69% of the transaction value. For Canada, based on the Bank of Canada's survey of merchants on their accepted means of payment in 2006, Taylor (2009) report that the average merchant discounts for accepting credit cards and debit cards are approximately 2% and 0.24% of transaction values, respectively. For Europe, Jones and Jones (2006) show that the average merchant fee for accepting credit cards is approximately 0.7-2.8% of the transaction value, and that for accepting debit cards is approximately 0.6% of the transaction value. As most payment cards in China were debit cards, the average merchant discount in our sample is higher than that for debit cards in other developed economies.

[18]The figure is reported in the top panel of Table 3. See the data section for details.

B Data

Table A2: Regulation of Interchange Fee (IF) and Network Fee (NF)

		Group 1 Catering & Entertainment	Group 2 Standard	Group 3 Well-being	Group 4 Non-profit
Regime 1:	IF	1.6	0.8	0.8	0.8
Mar. 2002-Feb. 2004	NF	0.2	0.1	0.1	0.1
Regime 2:	IF[19]	1.4	0.7	0.35	0
Mar. 2004-Feb. 2013	NF	0.2	0.1	0.05	0
Regime 3:	IF[20]	0.9	0.55	0.26	0
Mar. 2013-Aug. 2016	NF	0.13	0.08	0.04	0
Regime 4: Sep. 2016-Present	IF[21]	0.45 (credit) 0.35 (debit)	0.45 (credit) 0.35 (debit)	22% off for both cards	0
	NF[22]	0.065 for both cards	0.065 for both cards	22% off for both cards	0

Unit: Panel A - %. Panel B - Million for POS installed, Billion for card in circulation and RMB trillion for card purchase value. Note: Group 1: Hotels, restaurants, entertainment, jewelry and arts and crafts. Group 2: Most industries that do not fall into the other three categories. Group 3: Transportation, supermarkets and gas stations. Group 4: Public education and hospitals. Exception: Travel agency was classified into Group 1 in Regime 1, but into Group 2 in Regime 2-3. Real estate and automobile were classified into Group 2 in Regime 1-2, but into Group 1 in Regime 3.

Sources for Panel A and B: Same as Table 1.

[19]Group 2 - Real estate, automobile and wholesales. The maximum interchange fee (network fee) for each transaction in real estate and automobile is RMB 40 (5), and the maximum interchange (network) fee for each transaction in wholesale is RMB 16 (2).

[20]Group 1 - Real estimate and automobile: The maximum interchange fee, network fee and acquirer fee for each transaction in wholesales are RMB 60, 10 and 10, respectively. Group 2 - Wholesale: The maximum interchange fee, network fee and acquirer fee for each transaction in wholesales are RMB 20, 2.5 and 3.5, respectively.

[21]The maximum interchange fee for debit card is RMB 13, but there is no limit of interchange fee for credit card.

[22]The maximum network fee for both debit and credit card is RMB 6.5.

Table A3: Industries in our sample

Group 1	**Personal Service (7)**
Catering and Dining (2)	Laundry services
Hotel	Photography studio
Restaurant	Barber services
Entertainment (4)	Consulting services
Art & Craft	Massage
Dancing hall, school and studio	Beauty services
Membership club	Other personal services
Recreational services	**Commercial Services (9)**
Group 2	Advertising
Transportation & Communication (2)	Consumer credit report
Airport services	Commercial photograph, craft and drawing services
Telecommunication equipment	Programming and data processing
Retail (31)	Management, consulting and public relations services
Timber and building materials	Other business services
Department store	Car rental
Various supermarkets	Car service
Candy shop	Car wash
Dairy products	**Professional Services (8)**
Bakery	Doctor
Auto-parts store × 2	Dentistry
Clothing × 6	Optometrists and opticians × 2
Shoes and hats	Medical services
Fur	Other education services
Home decoration × 2	Construction, surveying and mapping services × 2
Electronic equipment	**Group 3**
Computer software	**Transportation & Communication (5)**
Fast food restaurant	Passenger transportation
Pharmacy	Airline
Sporting goods store	Travel agency
Bookstore	Fixed line phone service
Stationery, office and school supply	Cable and other pay TV services
Photographic equipment	**Grocery (2)**
Gifts × 2	Grocery stores and supermarket
Cosmetic	Gas station
Tobacco	**Group 4**
Kiosks and newsstands	**Public Services (2)**
	Hospital
	University

Table A4: Cities in our sample province

Area	GDPPC (RMB 1000)	NAPOP (%)	NMPOP (%)
Guangzhou	56.3	88.4	1.53
Zhuhai	41.8	100.0	4.12
Shantou	12.4	99.1	0.00
Foshan	47.7	100.0	1.50
Shaoguan	11.7	39.8	0.06
Heyuan	5.2	25.6	-0.17
Meizhou	7.0	24.5	-0.07
Huizhou	23.6	39.0	0.90
Shanwei	8.5	50.2	-0.21
Dongguan	72.0	38.5	1.36
Zhongshan	44.0	41.1	0.66
Jiangmen	21.6	57.4	-0.12
Yangjiang	10.5	31.9	0.27
Zhanjiang	9.7	28.1	-0.62
Maoming	11.2	36.9	-0.54
Zhaoqing	13.9	24.8	-0.20
Qingyuan	7.5	28.8	-0.22
Chaozhou	10.3	28.4	-0.13
Jieyang	9.1	34.6	0.65
Yunfu	9.8	37.4	-0.32

C Construction of the Variable HFraud

Fraud risk is used to estimate how the cost of providing card services to merchants affects payment card pricing. Although we do not observe fraud payments, we collect the internal fraud risk ratings at the industry level from the card network as a proxy. According to the card network, there are two steps in constructing the internal rating. First, based on the fraud transaction value across industries over the years 2004-2005, it calculates the industry-specific fraud risk of card payments using the share of the value of fraudulent transactions in an industry in total value of fraudulent transactions for all industries, i.e.,

$$\text{Fraud Risk}_i = \frac{\text{Fraud transaction value}_i}{\sum_{n=1}^{N} \text{Fraud transaction value}_n}$$

where N is the total number of industries. After computing the fraud risk of each industry, the card network defines the variable *Fraud* as a categorical variable taking values from 1 to 5, with larger values indicating greater fraud risk. An industry where *Fraud* takes 1 (such as bakeries) belongs to the group with the lowest fraud risk. An industry where Fraud takes 5 (such as jewelry) belongs to the group with the highest fraud risk.

There is a caveat related to the use of the *Fraud* variable; the internal rating only uses information related to payments denominated in foreign currency instead of the domestic currency. This variable may inflate the fraud risk for industries with high payment card use in foreign currency (such as department stores) and may deflate the fraud risk for industries with low payment card use in foreign currency (such as online stores and mail-order firms).

Because the *Fraud* variable does not cover all industries, the second step in constructing the variables employs the traceability of transaction and the average transaction value per purchase to assign the value of *Fraud* for the remaining industries contained in the merchant-level data. More specifically, it emphasizes the traceability of transaction in assigning the value of *Fraud* because greater tractability reduces the cost of enforcing the payments authorized by cardholders, which reduces card payment fraud risk. For a given level of traceability, a larger average transaction value per purchase increases the benefits of a fraud payment, which increases card payment fraud risk. Therefore, industries with more traceable transactions and smaller average transaction values per purchase are assigned smaller *Fraud* values.

Finally, in order to reduce the measurement error of the *Fraud* variable, we define a binary variable *HFraud* taking the value one for industries with the *Fraud* variable larger than two and zero otherwise.

D Variance Decomposition with Three Regressors

We follow the definitions of two relative importance methods (i.e., LMG and PMVD stated in Grömping (2006, 2007)) to derive specific formulas under the case of three regressors. Consider a model with three regressors

$$y = \beta_0 + x_1\beta_1 + x_2\beta_2 + x_3\beta_3 + \epsilon,$$

where $(\beta_0, \cdots, \beta_3)$ are unknown parameters. The error term ϵ with expectation 0 and variance $\sigma^2 > 0$ is uncorrelated to the regressors (x_1, x_2, x_3).

Specifically, for $q = 1, 2, 3$, define

$$R^2(\{q\}) = svar(\{q\}|\emptyset) = \frac{cov(y, x_q)^2}{var(x_q)}.$$

And, for $k = 1, 2, 3$ with $q \neq k$, let

$$\begin{aligned} R^2(\{q,k\}) &= (cov(y,x_q), cov(y,x_k)) \begin{pmatrix} var(x_q) & cov(x_q,x_k) \\ cov(x_q,x_k) & var(x_k) \end{pmatrix}^{-1} \begin{pmatrix} cov(y,x_q) \\ cov(y,x_k) \end{pmatrix} \\ svar(\{q\}|\{k\}) &= R^2(\{q,k\}) - R^2(\{k\}). \end{aligned}$$

Next, for $l = 1, 2, 3$ with $q \neq k \neq l$, let

$$svar(\{q\}|\{k,l\}) = R^2(\{1,2,3\}) - R^2(\{k,l\}),$$

where

$$R^2(\{1,2,3\}) = \begin{pmatrix} cov(y,x_1) \\ cov(y,x_2) \\ cov(y,x_3) \end{pmatrix}^T \begin{pmatrix} var(x_1) & cov(x_1,x_2) & cov(x_1,x_3) \\ cov(x_1,x_2) & var(x_2) & cov(x_2,x_3) \\ cov(x_1,x_3) & cov(x_2,x_3) & var(x_3) \end{pmatrix}^{-1} \begin{pmatrix} cov(y,x_1) \\ cov(y,x_2) \\ cov(y,x_3) \end{pmatrix}.$$

Then, the formulas for the relative importance of x_1, x_2 and x_3 based on LMG method are, respectively, given by

$$\begin{aligned}
LMG(x_1) &= \frac{2 \times svar(\{1\}|\emptyset) + svar(\{1\}|\{2\}) + svar(\{1\}|\{3\}) + 2 \times svar(\{1\}|\{2,3\})}{6} \\
LMG(x_2) &= \frac{2 \times svar(\{2\}|\emptyset) + svar(\{2\}|\{1\}) + svar(\{2\}|\{3\}) + 2 \times svar(\{2\}|\{1,3\})}{6} \\
LMG(x_3) &= \frac{2 \times svar(\{3\}|\emptyset) + svar(\{3\}|\{1\}) + svar(\{3\}|\{2\}) + 2 \times svar(\{3\}|\{1,2\})}{6}.
\end{aligned}$$

In addition, let

$$\begin{aligned}
m(\{q,k,l\}) &= \left(R^2(\{1,2,3\}) - R^2(\{q\})\right)^{-1} \times \left(R^2(\{1,2,3\}) - R^2(\{q,k\})\right)^{-1} \\
p(\{q,k,l\}) &= \frac{m(\{q,k,l\})}{m(\{1,2,3\}) + m(\{1,3,2\}) + m(\{2,1,3\}) + m(\{2,3,1\}) + m(\{3,1,2\}) + m(\{3,2,1\})}.
\end{aligned}$$

Then, the formulas for the relative importance of x_1, x_2 and x_3 based on PMVD method are, respectively, given by

$$\begin{aligned}
PMVD(x_1) &= [p(\{1,2,3\}) + p(\{1,3,2\})]svar(\{1\}|\emptyset) + p(\{2,1,3\})svar(\{1\}|\{2\}) \\
&+ p(\{3,1,2\})svar(\{1\}|\{3\}) + [p(\{2,3,1\}) + p(\{3,2,1\})]svar(\{1\}|\{2,3\}) \\
PMVD(x_2) &= [p(\{2,1,3\}) + p(\{2,3,1\})]svar(\{2\}|\emptyset) + p(\{1,2,3\})svar(\{2\}|\{1\}) \\
&+ p(\{3,2,1\})svar(\{2\}|\{3\}) + [p(\{1,3,2\}) + p(\{3,1,2\})]svar(\{2\}|\{1,3\}) \\
PMVD(x_3) &= [p(\{3,1,2\}) + p(\{3,2,1\})]svar(\{3\}|\emptyset) + p(\{1,3,2\})svar(\{3\}|\{1\}) \\
&+ p(\{2,3,1\})svar(\{3\}|\{2\}) + [p(\{1,2,3\}) + p(\{2,1,3\})]svar(\{3\}|\{1,2\}).
\end{aligned}$$