Analysis on the Market Effect of Industry Standard Competition for Bank Card

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Abstract: It can be known from comparison of competition for the bank card industry standard in the case of symmetry and asymmetry that multi-party holding and market-compatible market effect will be greater than the competitive effect held by one side. But for the multi-party holding act decision and market-compatible decision, consumer's net network effects under compatibility are greater than the net network effects held by multiple parties. There are weights in choice of bank card organization's decision in multi-party holding and market compatibility aspects because of differences of revenues. In addition, the card organizations with large market size lack power of promoting market compatibility because of profit and cost input problems under the condition of asymmetry.
Keywords: bank card, standard competition, market effect

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1. INTRODUCTION

In order to standardize the competition of the bank card industry, improve the security of bank card and the compatibility of bank cards in the international community, China UnionPay has transferred and upgraded the bank card EMV successively. So far, the standard of China's bank card has been upgraded from PBOC2.0 to PBOC3.0, and the related banking institutions, clearing organizations and merchants have upgraded the terminal equipment, software and bank cards accordingly. In developing and advancing implementation of the bank card standard process, although Chinese bank card PBOC standard transfer in accordance with the international EMV standard, compared with the international card organizations such as VISA and MasterCard and other bank card standards, it is not completely similar. The difference in standards among different card organizations produce transactions of manufacturers and consumers a lot of inconvenience with bank card as media, and related solutions based on it, for instance, the effect compatibility or incompatibility, and the uniformity of standards are

different for the market, thus it brings some enlightenment to the implementation of relevant policies.

2. COMPETITIVE EFFECT OF SYMMETRIC CASE

In order to analyze the competitive effect of the bank card industry standard, the Hotelling model is introduced. Assuming that there are two bank card organizations, their act and size are same, it expressed as i (i=1,2), each consumer can choose to purchase services of card organization 1 or card organization 2 or purchase the service of two organizations. To purchase card organization service can bring the net benefits to the consumer. For the sake of convenience, it is assumed that the network revenue is the linear function that the number of consumers access the service, that is bn, the parameter b varies depending on the consumer's evaluation, if the high probability α is used to evaluate the network revenue, that is b^H, otherwise the network revenue that low probability 1-α evaluate is b^L(b^H>b^L), mean value of the network revenue is $\beta = \alpha b^H+(1-\alpha) b^L$. The intrinsic revenue that consumers purchase services provided by a card organization is v_0, and the intrinsic revenue is not lower than the price of purchasing service, for the sake of convenience, intrinsic revenue that the consumer purchase service from the two card organizations does not increase, that is still v_0, service that consumer purchase card organization causes the difference in position to produce a certain traffic cost, assuming that the consumer is evenly distributed in the unit space, the distance from the card organization is x, is $T_i(x)=tx(2-i)+t(1-x)(i-1)$, transport costs that each consumer purchase service from card organization is is $T_i(x)=tx(2-i)+t(1-x)(i-1)$, (when the consumer chooses card organization 1, i=1, when choose card organization 2, i=2. In addition, high rating ratio that consumers choose to purchase services from card organization i, low rating ratio is ni. When consumers purchase card organization services, the net effect obtained is:

$$U_i=v_0-p_i-t_i(x)+bN_i \tag{1}$$

Where i = 1, 2, N_i is the number of consumers that can be accessed by the purchase card organization, p_i is the price of the purchasing card organization service, when the same consumer multi-party holding two card organization services, Net effect is:

$$U=v_0-p_1- p_2-t_1(x)-t_2(x)+bN \tag{2}$$

In the above formula, , because the card organization is distributed at both ends of the unit distance, the distance from the consumer to the two organizations is 1, so $t_1(x)+t_2(x)=1$,. Multi-holding act allows consumers to access all other consumers, so N=1, the above formula is rewritten as:

$$U=v_0-p_1- p_2-t+b \tag{3}$$

2.1 Situation without compatiblity and multi-party holding

It can been known from the above assumptions and formulas, when the consumer chooses card organization 1at position x, the effect of the purchase service is:

$U_1=v_0-p_1-tx+bN_1=v_0-p_1-tx+b[\alpha s_1+(1-\alpha)n_1]$

In formula, $N_1=\alpha s_1+(1-\alpha)n_1$.

Similarly, when the consumer purchase the service of the card organization 2, the net effect obtained is:

$U_2=v_0-p_2-t(1-x)+bN_2$

further adjusted: $U_2=v_0-p_2-t(1-x)+b[(1-s_1)+(1-\alpha)(1-n_1)]$

Because the consumers are evenly distributed in the unit space, if consumers does not have multi-party holding behaviour, and purchase the service of two card organization, number that consumer purchase service of the two card organizations is equal,

$U_1(s_1,b_H, N_1)= U_2(s_1,b_H, N_2)$

$U_1(s_1,b_L, N_1)= U_2(s_1,b_L, N_2)$

Among them, $U_1(s_1,b_H, N_1)=v_0-p_1-s_1x+b_H[\alpha s_1+(1-\alpha)n_1]$

$U_2(s_1,b_H, N_2)=v_0-p_2-t(1-s_1)+b_H[(1-s_1)+(1-\alpha)(1-n_1)]$

$U_1(s_1,b_L, N_1)=v_0-p_1-s_1x+b_L[\alpha s_1+(1-\alpha)n_1]$

$U_2(s_1,b_L, N_2)=v_0-p_2-t(1-s_1)+b_L[(1-s_1)+(1-\alpha)(1-n_1)]$

simultaneously solve the above equation, it can get

$s_1=1/2+(p_1-p_2)/2t+(p_2-p_1)b_H/2t(t-\beta)$

$n_1= 1/2+(p_1-p_2)/2t+(p_2-p_1)b_L/2t(t-\beta)$

$N_1=1/2+(p_2-p_1)/2(t-\beta)$ $N_2=1/2-(p_2-p_1)/2(t-\beta)$

The card organization i obtain benefit by the consumer's purchase of the services it offers, assuming that the marginal cost of providing the service is f, and the average fixed cost is c, the profit obtained is:

$\pi_1=(p_1-f-c)[1/2 + (p_2-p_1)/2(t-\beta)]$

$\pi_2=(p_2-f-c)[1/2 - (p_2-p_1)/2(t-\beta)]$

Take the first derivative of the above formula, and conclude that the equilibrium price of each card organization is:

$P_N=p_1=p_2=f+t+c-\beta$

Because the card organization is symmetrical, so each card organizations in order to obtain network scale revenue to compete, in the absence of compatibility and multi-party holding, the equilibrium profit that each card organizations obtain:

$\pi_N=(t+c)/2 -\beta/2$

According to the above, the benefits of the whole society should be equal to the producer surplus of card organization and the surplus of the consumers in the case of neither compatible nor multi-party holding.

$W=CS+PS=v_0+\beta/2- f-c-t/4-2(1-\delta)[(t+c)/2-\beta/2]$

In the above social benefits, the first five items are consumer surplus and producer surplus. At the same time, due to the existence of monopoly and product differentiation reasons, profits

which are higher than the costs, so that there are discount when consumer' surplus transfer to the card organization, if the weight ratio in welfare of firm is δ, then the last one is further adjustment of residual discount of card organization.

2.2 The situation of multi-party holding

When consumers purchase services of more than two bank card organization, it means that consumers have make a multi-party holding act. It can be reasonably introduced based on the previous assumptions, consumers with low evaluation of the network income choose to multi-party holding act less, and consumers with high evaluation of the network income will make a multi-party holding act. It can be assumed that the consumers with low evaluation only purchase services of a card organization, and card organization with high evaluation make a multi-party holding decision, then this means $s_i=1, N_i=\alpha+(1-\alpha)n_i, i=1,2$.

The consumers who purchase services of a card organization can then access to all consumers with l high evaluation and consumers with low evaluation with n_i ratings. When the consumer is in position x in the unit space, only the effect of the service which is purchased from card organization 1:

$$U_1=v_0-p_1-t\,(x)+b[\alpha+(1-\alpha)n_1] \tag{4}$$

When it only purchases the the service of card organization 2, the effect obtained is:

$$U_2=v_0-p_2-t\,(1-x)+b[\alpha+(1-\alpha)(1-n_1)] \tag{5}$$

When a buying services of two card organization, the effect is:

$U=v_0-p_1-p_2-t+b$

It can been known from that the market equilibrium by consumer purchase services of card organization:

$U_1(n_1,b_L,N_1)= U_2(n_1,b_L,N_2)$

Solve and gain $n_1=1/2 +(p_2-p_1)/2[t-(1-t)b_L]$

The profitability that the card organizations obtain is

$$\pi_i=(p_i-f-c)[\,\alpha+(1-\alpha)n_i] \tag{6}$$

Under the condition that consumers with high evaluation multi-party hold, the goal of the card organization competition is unilateral holding, they are the consumer who only purchase a card organization services, so the first derivative of (6):

$P_M=p_1=p_2=f+c+[/(1-\alpha)]*[t-(1-\alpha)b_L]$

Profit is:

$\pi_M=[(1+\alpha)^2/2][t/(1-\alpha)-b_L]$

Social welfare of multi-party holding is:

$W_M = v_0 + \alpha b^H + (1-\alpha)b^L/2 - (1+\alpha)(f+c) - (1+3\alpha)t/4 - 2(1-\delta)(1+\alpha)^2[t/(1-\alpha)-b^L])$

In the above social benefits, the first five items are the consumer surplus and the producer surplus, the first three items are the intrinsic effect and the network effect of the consumers; the fourth and the fifth item are the production costs and consumer transport cost of the card organization services; the last one is the loss caused by the consumers' surplus transfer to the producers' surplus after the costs rise.

2.3 Compatible situations

When each bank card organization implements compatible strategy in pursuit of scale effects, the cost of each card organization will increase, in addition to the original marginal unit cost and the average fixed cost, it will also accept the compatible cost of another bank card organization standard. The implementation of compatible strategic act for consumers who have a bank card, on the one hand, the cost of multi-party holding act is reduced, on the other hand, the net profit obtained will be greater.

For a consumer in a spatial location x, the profit obtained is:

$U_1 = v_0 - p_1 - tx + b$

In the above formula, because the bank card organization implement compatible strategy, consumers who purchase a single card organization 1 service will be access to the rest of staff' network income, so the network income is b. Similarly, the consumers who purchase card organization 2 services, the profit obtained is:

$U_2 = v_0 - p_2 - t(1-x) + b$

If the consumer is holding in multi-party, the profit obtained is:

$U = v_0 - p_1 - p_2 - t + b$

Because of the compatibility for consumers, multi-party holding act decisions will not receive additional network benefits, and will pay more subscription and transportation costs, so in the case of compatibility, consumers will not make multi-party holding irrational act decision, but rationally do unilateral holding act (singlehome).

In the case of compatibility, all consumers choose unilateral holding, the card organization gains profits:

$\pi_i = (p_i - f - c)[\alpha s_i + (1-\alpha)n_i] - F$

Where $s_i = n_i = 1/2 + (p_2 - p_1)/2t$, F is the fixed cost payment that the card organization i accept from another standard when consumer purchase service.

The card organization 1 and card organization 2 profit formula take a first derivative, respectively:

$P_c = p_1 = p_2 = f + t + c$

The profit that the card organization obtain is:

$\pi_c = t/2 - F$

Social welfare under compatible conditions is:

$W_c = v_0 - \beta - f - t/4 - 2F - 2(1-\delta)(t/2 - F)$

2.4 Comparison of several decisions

The results and effects of different act decisions of consumers and card organizations are different, three different decisions can be compared to find:

For multi-party holding and unilateral holding:

$\triangle p = p_M - p_N = [(1+\alpha)/(1-\alpha)]*[t-(1-\alpha)b_L] - t + \beta > 0$

$\triangle \pi = \pi_M - \pi_N = (p_i - f - c)[\alpha + (1-\alpha)n_i] - (t+c)/2 - \beta/2 > 0$

$\triangle CS = CS_M - CS_N = t - \beta - [(1+\alpha)/(1-\alpha)]*[t-(1-\alpha)b_L] < 0$

$\triangle W = W_M - W_N > 0$

It can be seen that network effect that brought about multi-party holding from price to profit, so that the price of card organization is higher than the unilateral holding price, profits increased, but the consumer surplus fell, the reason lies in existence network effect, consumer multi-party holding act decisions make the card organization less competitive and can determine the higher price. Although the consumer surplus due to the relative decline of the number of multi-party holding, but there are greater network effects. In terms of social welfare, compared with unilateral holdings, because not only consumers enjoy the network benefits, the card organizations also get more benefits from the consumers' multi-party holding act decision, so compared to unilateral holdings social welfare of multi-party holding increased.

For multi-party holding and compatibility:

$\triangle p = p_C - p_M = f + t + c - f - c - [(1+\alpha)/(1-\alpha)]*[t-(1-\alpha)b_L]$

$= t - [(1+\alpha)/(1-\alpha)]*[t-(1-\alpha)b_L] > 0$

$\triangle \pi = \pi_C - \pi_M = t/2 - F - [(1+\alpha)^2/2][t/(1-\alpha)-b_L]$(undetermined)

$W = W_C - W_M = v_0 - \beta - f - t/4 - 2F - 2(1-\delta)(t/2-F) - v_0 - \alpha b^H - (1-\alpha)b^L/2 + (1+\alpha)(f+c) + (1+3\alpha)t/ + (1-\delta)(1+\alpha)^2[t/(1-\alpha)-b^L]$(undetermined)

It can be known by compare the profits of two when:

$t/2 > F + [(1+\alpha)^2/2][t/(1-\alpha)-b_L]$

The profits that compatible decision gains are more than multi-party holding profits, which means that, first, product differentiation is large enough; second, the cost of product compatibility for card organization is low enough. Because product differentiation make consumers do multi-party holding act will also raise the card organization's profits, thus offsetting the profits brought about by compatibility. At this time, to make the compatible profit greater than the profits under the condition of multi-party holdings, the cost of product compatibility among card organizations must be low enough. Third, b_L value is larger (meanwhile $t > b_L$), namely, the proportion of low evaluation is larger.

The comparison between compatibility and unilateral holding:

$\triangle p = p_C - p_N = f + t + c - f - t - c + \beta = \beta > 0$

$\triangle \pi = \pi_C - \pi_N = t/2 - F - (t+c)/2 + \beta/2 = \beta/2 - F - c/2 \geq 0$

As can be seen from the above comparison, the first term illustrates the greater network benefits brought about by compatibility, which allow card organization to set higher prices, and does not consider low price caused by competing act due to incompatible unilateral holding act. Due to the high price of the first item in front, the second item must be greater than zero. The profit of greater network benefits brought about by the compatibility is bound not less than profits obtained before compatibility, namely, the second network effect is greater than the fixed cost and marginal cost for this, or will refuse to another card organization platform (ie, standard) access, and continue to maintain unilateral unacceptable act. Therefore, the second item must not be less than the profits held by the single side.

It can be seen from above analysis that the competition decision comparison of different standards, in the case of symmetry, effects caused by compatibility and multi-party holding decision is higher than the unilateral holding effect in the price and profit, but there are difference in price and profit for compatibility and multi-party holding due to product differences (standard differences), network effects and cost inputs.

3. COMPETITIVE EFFECT OF THE ASYMMETRIC SITUATION

When the enterprise market size and market entry and other aspects have asymmetry, the competitive effect of card organization standard and the choice of symmetry conditions will be different. Due to the implementation of different standards, different markets has been formed, if the card organization abandon standard has been adopted, the input cost that original standard input costs abandon and implement the new standard, it means more cost payment, and compete with the incumbent, it will not have an advantage as a latter entrants. Therefore, the analysis of competitive effect under asymmetric conditions is mainly aimed at multi-party holding decision and compatible decision analysis. Because unilateral holding act analysis is the same as symmetric case, there is no analysis.

For bank card organization, the asymmetric condition is expressed as the difference between market size and order entry. Under the condition of asymmetric condition, it is assumed that the proportion of low evaluation for the network effect of enterprise 1 is n_1, the proportion of the high evaluation is s_1, which is consistent with assumption of previous model, $n_2=1-n_1, s_2=1-s_1$, $s_1 < n_1, s_2 > n_2, s_1+n_1 < s_2+n_2$. $s_1+n_1 < s_2+n_2$ means that the market size that card organization 1 face is less than the market size of card organization 2 among them, then under the network effect, card organization with high evaluation is more inclined to take multi-party holding act. In order to simplify the analysis, it is assumed that only highly evaluative selection multi-party holding act decisions. It can be seen that under the multi-party holding act decisions, due to the lack of competition, the two card organizations will obtain incremental benefits because of the multi-party holding act of consumers, but due to differencesof different markets sizes, ther are also differences in incremental size obtained.

Under the multi-party holding act,

The profit increment of card organization 1 is: $\triangle \pi_1 = s_2 (p_1-c)$

The profit increment for card organization 2 is: $\triangle \pi_2 = s_1 (p_2-c)$

Market competition, the equilibrium price of competition is $p_1=p_2$, it can be seen under multi-party holding, the consumers' multi-party holding revenue obtained of card organization with small market size are higher than the benefits of card organization with large market size. But network revenue increment consumers obtain only make multi-party act decision-makers appear, multi-party holding act decision does not exist. And the additional purchase costs are increased in order to gain additional network revenue.

When the card organization take compatible act, each card organization need to make a fixed investment in order to access platform of other side, but fixed input costs that different market size need are different, the fixed-cost inputs that card organization with large market size in order to access to platform of other card organization with small market size will be greater than fixed-cost inputs that card organization with small market size access to the card organization with large market size. In consumers' network revenue, due to compatibility, the consumption of two card organizations, whether low evaluation of consumers or high evaluation of consumers will get compatible network benefits, but consumers' revenue of card organization with small market size is greater than network revenue of card organization with large market size.

Under asymmetric conditions, the card organizations take multi-party holding act decision and the compatible decision depends on the size of revenue of two. If the multi-party holding profit is greater than the compatible profit, the card organization will approve of the multi-party holding act; if the market-compatible profits are greater than multi-party holding profit, the market compatibility will be recommended. But it can be seen by compared with the revenue of card organization; the card organization with large market size has a lower motivation to make compatible decision than card organization with small market size.

4. CONCLUSION

It can be seen from comparison of competition between symmetry case and asymmetry case that the market effect of multi-party holding and market compatibility is greater than competitive effect of unilateral holding. But for the multi-party holding act decision and market-compatible decision, the consumer's net network effect under compatibility is greater than the net network effect held by multi-party. The decision of card organization in multi-party holding and market- compatible options has a trade-off due to differences in revenue. In addition, under asymmetric condition, the card organizations with large market size lack power of promoting market compatibility due to profit and cost investment problems.

The current technical standards of international bank card are PBOC3.0 technical standard that China UnionPay implement and EMV technical standard that international VISA, MasterCard, JCB and other international card organizations adopt , China as a latecomer for technical standard promotion, the inconsistency between implementation of the PBOC standard and international EMV standard cause the international cross-border transactions

clearing to difficult, the solution to this problem is to issue is a double-standard card before, but after 2010, China will no longer issue such cards, and it means that both bank card that China UnionPay organization issued and issued by the international card organization in order to enter the market of other side, or establish their own clearing network and channel, or rent and compatible with other's clearing network platform. The establishment of their own clearing network means a huge input costs; mutual compatibility means that the bank card organization not only enter the market card of other side and related transaction settlement platform upgrade, but also own market clearing network should also be upgraded, which is also a huge cost input. But in contrast, the input cost of compatibility is relatively low compared to the input cost of building a settlement network platform separately, consumers share greater network utility as well. However, the UnionPay organization in the settlement of transnational clearing, the implemented solution is to establish a separate international clearing channels and networks, while the other international card organizations have not taken further measures compatible to UnionPay card based on PBOC technical standards, they form relatively independent clearing network platform separately, so that consumers must choose either anti-party holding or multi-party holding act decision, it not only reduces the consumers' surplus, but also the welfare of the whole society decline.

REFERENCES

[1] Xu Li, Chen Hongmin, Performance research of bank card organization based on different market structure [J], Journal of Industrial Engineering and Engineering Management, 2007, 3: 35-38.

[2] Yang Yin, International experience and its implications OF EMV migration [J], Financial Practice, 2009, 10: 65-67.

[3] Xu Yang, EMV migration on influence and strategies for development of China's bank card [J], 2009, 5: 91 ~ 93.

[4] Wei Peng, Bank card chip migration: driving force, barriers and opportunities [J], Financial Theory&practice, 2009, 4: 114-116.

[5] Lynn. Pepper, Dan. Richards: Industrial organization theory: modern theory and practice [M], Beijing: China Renmin University Press, 2014, (5).

[6] Toker Doganoglu and Julian Wright (2003):"Multihoming and Compatibility" Working Paper NO.0314.

[7] Rattanasuda Poolsombat and Gianluigi Vernasca(2006):"Partial Multihoming in Two-sided Markets "Discussion Paper in economics.

[8] Ari Hyytinen-Tuomas Takalo(2004): "Multihoming in the market for payment media: evidence from young finish consumers" Discussion Paper.