SUSTAINABLE GROWTH OF PAYMENT CARD NETWORKS: A TWO-SIDED MARKET APPROACH

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Abstract

The payment card industry is a typical "two-sided market" where two groups of agents (i.e. merchants and cardholders) interact with each other via a common network platform (i.e. a card network) and the value of participating in the network for agents in one group depends on the number of participants from the other group. The positive network externalities across the two sides create the "chicken-and-egg problem": without sufficient merchants accepting a particular card network, few consumers are willing to apply for the card; without sufficient cardholders, few merchants are willing to accept the card. While economists have addressed the issue from social welfare perspective, we focus on business strategy implications. Modeling network externalities in dynamic systems, we show that network platform owners could overcome the "chicken-and-egg problem" through strategies such as merger and acquisition, licensing, forming strategic alliance, as well as adjusting product and pricing strategies, etc. We provide a history of the U.S. payment card industry as empirical evidences to support our findings.

Introduction

The payment card network has recently attracted much attention from researchers (Chakravorti, 2003; Rochet & Tirole, 2002, 2003; Schmalensee, 2002; Wright, 2003a, 2003b, 2004) due to its special structure: two different groups of agents, the merchants and the consumers, interact with each other via the payment card networks; and the value of participating in a particular card network for agents in one group (say, merchants) depends on the number of participants from the other group (the consumers, correspondingly). For example, if more consumers carry VISA card, merchants accepting VISA card will be able to capture higher sales volume from these cardholders; on the other hand, if more merchants accept VISA card, it will be more convenient for VISA cardholders to pay for their purchases.

Such positive network effect also exists in other markets. For example, in yellow directory business, more advertising in a particular directory leads to more consumer usage, which in turn leads to more advertising in that directory (though in the next publication); in the PC industry, if more consumers use Windows operating system, more software developers would like to write application software for this system, which will make the system even more appealing to consumers. Similar phenomena can also be seen in the markets for academic journals, advertising, shopping malls, dating services and nightclubs, etc.

Markets with such cross-group network effect are termed as "two-sided markets" (Armstrong, 2004; Rochet & Tirole, 2003). The cross-group network effect is a double-edge sword: it can either lead to spiral growth of the network or create the "chicken-and-egg problem." For example, if few consumers carry VISA cards, few merchants would be willing to accept VISA, which further discourages consumers from using this type of cards. Unless the network has reached a critical mass in the number of participants, it cannot take off.

While the "chicken-and-egg problem" in two-sided markets has been discussed in the economics literature, few focus on how to overcome it from business strategy perspective. In this paper, we use a dynamic system model to provide mathematical explanations to the "chicken-and-egg problem" and explore strategies for overcoming it. Such strategies include merger and acquisition, licensing, forming strategic alliance, as well as adjusting product and pricing strategies, etc. We provide a historic account of the U.S. payment card industry to demonstrate relevance of our findings to business strategies in two-sided markets.

The paper is organized as follows. We introduce the characteristics of two-sided markets in section II, followed by a brief literature review in section III. In section IV, we present a dynamic system model of network growth and study the long-run behavior of the system. In section V, we propose business strategies for overcoming the "chicken-and-egg problem" based on model findings in the previous section. In section VI, we study the U.S. payment card industry and demonstrate the relevance of our propositions. Section VII summarizes and concludes.

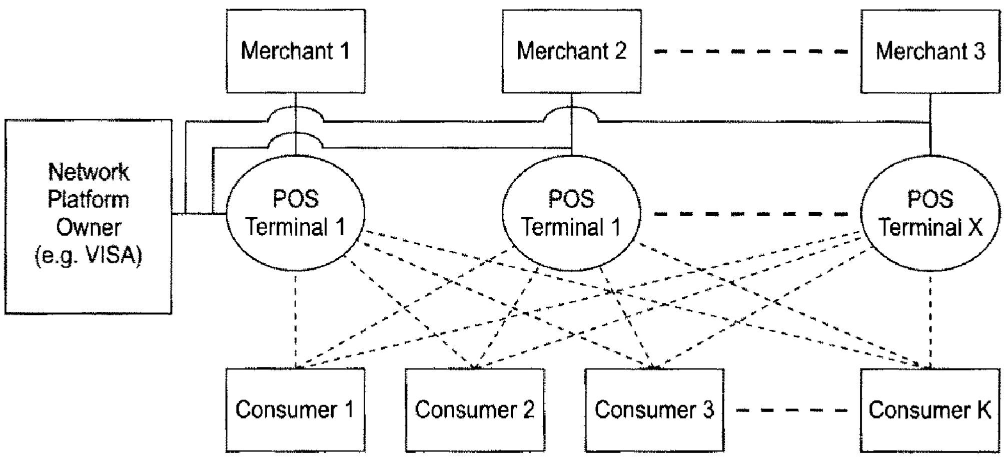
Characteristics of two-sided markets

Network structure

In a two-sided market such as the payment card network, the two sides interact with each other through a common *network platform*. For example, in the payment card network, the electronic payment systems and equipment (e.g. point-of-sale (POS) terminals) are the platforms via which consumers interact with merchants; the hardcopy yellow directory provide a platform via which thousands of households find information about the merchants who advertise in the directory. Besides the two sides, there is a third party who creates and services the network. We call it *network platform owner or sponsor*. VISA, MasterCard, American Express, and Discover are platform owners of the U.S. payment card network; SBC, Verizon and other yellow directory publishers are platform sponsors in the yellow directory business; Microsoft and Apple Computer are platform owners in the PC operating systems market.

Figure 1 illustrates the payment card network. Merchants represent one side of the market and consumers represent the other side. Each merchant installs a POS terminal in its store, which is linked to the electronic payment system owned by network platform owners (e.g. VISA, MasterCard). Consumers can purchase goods or services from any merchants in the network. The platform owners operate the payment system and provide services to network participants (e.g. clearing & settlements, fund transferring, fraud protection).

Figure 1
The Payment Card Network



(Note: Solid lines represent physical connection, dashed lines represent potential connection.)

In many two-sided markets, there is also a 4th type of agents which has not been discussed in the two-sided market literature. We call them the *distributors* of a network. They are the agents who produce and sell network-specific products to participants on either or both sides of the market. In the payment card network, banks such as Bank of America, Wells Fargo, Chase, etc. issue VISA or MasterCard cards to consumers and sign up merchants. They are neither the network platform owner nor any side of the market. Instead, they are the distributors of the corresponding network (i.e. VISA or MasterCard).

The roles of network distributors are not essential in a two-sided network because a network platform sponsor may decide to take this role by itself and not allow any distributors in its network. For example, American Express had been issuing its Amex cards to cardholders solely by itself until 2004 when it started to allow distributors (i.e. banks) to issue Amex-branded cards. Discover, the owner of the fourth largest credit card network in the U.S., is still the only distributor of its proprietary Discover card network as of today.

Although inessential to a two-sided network, network distributors may affect the diffusion speed of a network. Their collective efforts in signing up network participants and in improving the quality and features of the network could have a critical impact on the growth and even survival of a network, as will be shown later in the paper.

Cross-group vs. within-group network externalities

The defining characteristics of two-sided markets are the *cross-group network externalities*. For example, a consumer's decision to use VISA card imposes positive externalities to merchants, while a merchant's decision to accept VISA card imposes positive externalities to consumers. Such *cross-group network externality* represents an instance of *indirect network externalities* (Katz & Shapiro, 1985).

Besides cross-group externalities, there could also be *within-group externalities*, either positive or negative, within either side of the market. For example, in the payment card network, negative externalities exist among merchants: given the number of cardholders, more merchants in a particular card network will lead to less incremental sales from accepting the card for an individual merchant. This is because merchants are competing against each other for businesses from the same cardholders. Such negative within-group externality is called the *congestion effect* (Rysman, 2004, p.484) and can also be found in other two-sided markets such as yellow directory, shopping mall, dating services, and PC operating system.

Fee structure

Usually, the two sides of the market can interact with each other without a network, though it will be at greater inconvenience. For example, a consumer could purchase goods from a merchant using cash or checks. However, such transactions are less convenient to both sides than using credit cards: consumers need to bring enough cash, sometimes in large amount, which could be beyond their current liquidities or could be easily lost or stolen; merchants may face the risk of returned checks or counterfeiting money as well as lost business due to consumer's lack of finance from credit cards.

Since the network platform provides added-value to both sides of the market, the platform owner can charge both sides for its service, either on lump-sum basis or on per-transaction basis. For example, payment card network owners (e.g. VISA) charge merchants on per-transaction basis which is usually 2-3% of the transaction value. They could also charge cardholders a lump-sum membership fees, although most choose not to do so or only charge cardholders of certain risk profiles (e.g. those with low credit scores).

Literature Review

Recent research on two-sided markets is an extension of research on network effects. According to Katz and Shapiro (1985, p.424), "There are many products for which the utility that a user derives from consumption of the good increases with the number of other agents consuming the good." The definition does not distinguish the cross-group network externality from within-group externality.

Recent literature on two-sided markets makes this distinction and focuses on the former. Rochet and Tirole (2003, pp.990-994) and Armstrong (2004, pp.3-7) provide extensive review of literature on and examples of two-sided markets. Examples of two-sided markets and related research include payment card systems, telecommunication (Armstrong, 2002; Wright, 2002), advertising/yellow directory (Gabszewicz, Lauussel, & Sonnac, 2001; Dukes, 2003; Dukes & Gal-Or, 2003; Rysman, 2004), matchmaker (Caillaud & Jullien, 2001, 2003), and shopping mall (Pashigan & Gould, 1998).

The economics literature on two-sided markets focuses on entry and pricing decision of network owners in static equilibrium model settings. Their major interests are market efficiency and social welfare. In other words, they ask whether the network owner, either in monopolistic or in competition scenarios, will charge more or less than the social optimal price; whether there is too much or too little competition in either or both sides of the market.

The present paper differs from the economics literature in two aspects. First, instead of studying the welfare implications, we take the business strategy perspective. We seek for managerial solutions to overcoming the "chicken-and-egg problem." Second, unlike the existing literature which uses static equilibrium modeling approach, we use dynamic system approach. In the static equilibrium approach, the positive feedback across the two-sides of the market is modeled through the "expected" size of the network, rather than the actual size. This is because that, given there is only one period in a static model, it is impossible to allow an agent's decision to be based on the network size in the previous period. Therefore, the positive feedback loop can only be modeled in a simultaneous decision-making process where each agent forms an expectation of how many agents from the other side of the market will participate in the network at the end of the decision-making process. A higher expectation on other agents' participation decision will make an agent more willing to participate herself, which demonstrates the positive feedback loop. However, to find equilibrium for such static models, we need to assume that all agents have correct expectation, or "fulfilled expectation" (Katz & Shapiro, 1985, p.424), of other agents' participation decisions. The "chicken-and-egg problem" arises when agents have such low expectation of other agent's participation that nobody finds it worth participating. In equilibrium, nobody participates because nobody anticipates others to participate, which "fulfills" everybody's initial expectation.

Although the expectation on network size does play an important role in an agent's participation decision, we feel more appropriate to assume that most people make their decisions on what they have seen in the market instead of on what they expect to see in the market. In other words, they make participation decisions based on the actual size of the network, instead of the expected size. Therefore, we use dynamic systems approach which assumes that an agent's decision in the current period depends on the actual network size in last period. Such approach models the positive feedback loop across the two sides of the market in an explicit and sequential way. We focus on the long-term behavior of the dynamic system, which is analogous to the equilibrium concept in the static modeling approach.

Our modeling approach is most similar to Tse (2002). Tse models network effects in high-tech industry in the form of dynamic systems. His model involves both cross-group network effect and within-group network effect (such as word-of-mouth effect and bandwagon effect). We take similar approach but focus on two-sided markets with specific model settings relevant to markets such as payment card, yellow directory, PC operating system, and video game console.

A Dynamic System Model for Network Growth

In this section, we study the growth of a payment card network. Though the model is based on the market structure of the payment card system, it is also applicable to other two-sided markets with similar structures such as yellow directory, and PC operating system. Therefore, although we discuss the findings using the payment card industry as a background, the business insights in the propositions are stated in such as way that it is also applicable to other two-sided markets.

Basic model settings

We assume there are infinite merchants and consumers in the market[1]. Among them, X merchants and K consumers have joined the network. Each consumer, either in or out of the network, will purchase $\$q$ (where $q > 0$) of goods or services from the merchants. Therefore, the total spending of in-network consumers is $\$K*q$. We assume in-network consumers will buy only from in-network merchants and their spending will be evenly distributed among these merchants. The spending of out-of-network consumers will be captured by both in-network and out-of-network merchants and be evenly distributed among all merchants. Thus an in-network merchant will be able to capture more sales than an out-of-network merchant and the difference is $\$\frac{Kq}{X}$.

We assume that each consumer gets an incremental benefit of $\$b$ per dollar of purchase made in network. In the payment card example, the benefit might reflect the convenience of using credit cards for purchase, the purchase rebate offered by card issuers and/or the extra liquidity provided by the cards. In exchange for the benefit, the network owner/sponsor charges in-network consumers a lump-sum membership fee of $\$z$. Besides the benefits a consumer may obtain from each in-network transaction, there are also potential risks of using the network. For example, each transaction increases a cardholder's exposure to identity thefts as well as to hidden fees charged by credit card issuers. Each transaction also increases the balance of the credit card account, which exposes the cardholder to higher probability of delinquency and/or personal bankruptcy in the future[2]. Therefore, we should also account for such negative potentials in the model by assuming a risk factor f per transaction. Thus the net benefit per in-network transaction for a consumer participant is $(b - f)$.

On the merchant side, we assume the network owner/sponsor charges in-network merchants fees on both per-transaction and lump-sum basis. We denote the lump-sum fee as C_F and the per-transaction fee as C_V. Such fees are fixed and variable costs from the merchant's perspective.

We assume that consumers and merchants are willing to join the network if the net benefits from joining the network are positive. For consumers, the benefit of joining the network is $q(b - f) - z$. However, since the number of in-network merchants is less than the total number of merchants, consumers need to incur incremental search cost and/or transportation cost in order to purchase from an in-network merchant. The larger the number of in-network merchants (i.e. X), the smaller the search/transportation cost is. As the number of in-network merchants grows, the search/transportation cost becomes smaller and smaller and it approaches to zero when X reaches infinity. This implies that the search/transportation cost is a convex function of X. For simplicity, we assume that the search/transportation cost function is a unit search cost t multiplied by the inverse of X, which can be interpreted as the normalized average distance between any two in-network merchants multiplied by a unit search/transportation cost.

Finally, we clarify that all the parameters mentioned above are non-negative numbers.

Willingness to participate

After incorporating all cost and benefit factors, the net benefit for a consumer to become a network member (NB_C) is

$$NB_c = q(b - f) - z - \frac{t}{X} \tag{1}$$

If $NB_c > 0$, a consumer is willing to join the network. The larger the net benefit, the stronger the incentive for consumers to join the network. It can be seen from (1) that the search/transportation cost is one of the sources of the cross-group network effect: the larger the number of in-network merchants, the larger the net benefit for a consumer to join the network.

For merchants, the net benefit of being an in-network merchant (NB_M) is

$$NB_m = \frac{Kq}{X}(r - C_V) - C_F \tag{2}$$

where r represents the profit margin from incremental sales. It can be seen from (2) that a larger K will make the benefit of being an in-network merchant larger, which gives the cross-group network externality on merchants by consumer's participation in the network. The function for NB_M also reveals the negative within-group externality among the merchants: the higher the X, the lower the NB_M. This reflects the *congestion effect* mentioned earlier.

Network growth dynamics

Due to incomplete information, technical constraints, consumer inertia or other possible reasons, not every consumer or merchant willing to join the network will be able to do so altogether. Instead, we assume that network adoption is a dynamic process and the changes in the number of in network consumer or in-network merchants are positively related to the net benefit of joining the network. This defines a two dimensional non-linear dynamic system:

$$\dot{X} = \alpha\left[\frac{Kq}{X}(r - C_V) - C_F\right] \tag{3}$$

$$\dot{K} = \beta\left[q(b - f) - z - \frac{t}{X}\right] \tag{4}$$

where $\alpha > 0$, $\beta > 0$ measure the speed of change per unit of NB_M and NB_C respectively. Note that α, β can be affected by a network owner's actions such as advertising, marketing promotion, technological progress, etc. It is also affected by the number of *distributors* in the network. We also assume $q(b - f) - z > 0$ and $r > C_F$ because otherwise there will never be a chance for $NB_M > 0$ or $NB_C > 0$ no matter how large K or X is. In other words, if these assumptions are not satisfied, no consumer or merchant will ever be willing to join the network and the network will never exist.

It can be shown that the system has a unique equilibrium point:

$$\begin{cases} \overline{X} = \dfrac{t}{q(b - f) - z} \\ \overline{K} = \dfrac{C_F t}{q(r - C_V)[q(b - f) - z]} \end{cases} \tag{5}$$

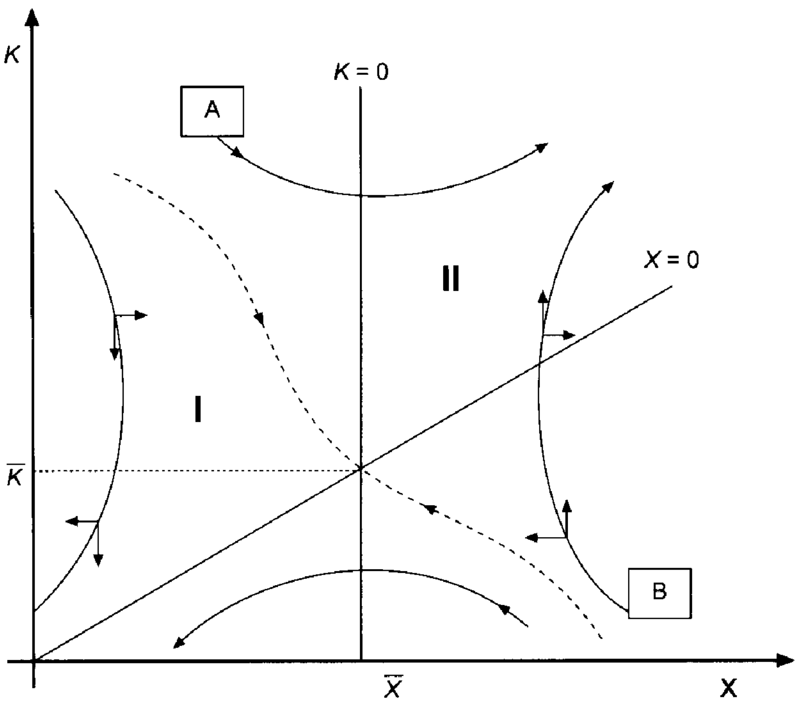
It is easy to see that the equilibrium is in the positive quadrant given that $[q(b - f) - z] > 0$ and $r > C_F$. To understand the stability of the equilibrium, we apply the linearization method around the equilibrium point and obtain the two eigenvalues of the corresponding linear system:

$$\lambda_1 = \frac{[q(b-f)-z]\left[-\alpha C_F + \sqrt{\alpha^2 C_F^2 + 4\alpha\beta q(r - C_V)[q(b-f)-z]}\right]}{2t}$$

$$\lambda_2 = \frac{[q(b-f)-z]\left[-\alpha C_F - \sqrt{\alpha^2 C_F^2 + 4\alpha\beta q(r - C_V)[q(b-f)-z]}\right]}{2t} \tag{6}$$

Since $[q(b-f)-z] > 0$ and $r > C_V$, the two eigenvalues have opposite signs which means that the equilibrium is a *saddle point* (Sanchez, Allen & Kyner, 1988, pp. 493-494). Therefore, there is a *saddle path* (the dashed curve in Figure 2) that separates the space into two distinct regions. Starting from any point above this curve, the system will grow forever; starting from any point below the curve, the system will eventually move to the negative quadrants; starting from any point on the curve, the system will converge to the equilibrium ($\bar{X}$, $\bar{K}$).

Figure 2
Phase Diagram for the Growth of a Network in Two-Sided Markets



Managerial Insights

The "chicken-and-egg" problem

The dynamics shown in the phase diagram (Figure 2) illustrate the "chicken-and-egg" problem. If a network started with small numbers of merchants and consumer members, it can never move across the saddle path and its growth cannot be sustained. Eventually, the network will shrink to zero as the small number of participants on one side of the market cannot provide large enough value to attract or keep participants from the other side. However, if a network can manage to gather enough participants on both sides of the market at the very beginning, the network will be able to grow to infinity on its own momentum.

It is interesting to see from the phase diagram that a network needs not have large numbers of participants from both sides of the market in order to achieve sustainable growth. Instead, as long as it has sufficient participants from one side of the market, it will be able to achieve sustainable growth. This is illustrated by point A (where $X < \overline{X}$ or $K < \overline{K}$) and point B (where $X < \overline{X}$ or $K < \overline{K}$) in Figure 2. Both points lie above the saddle path, even though there are fewer participants from one side of the market than in the equilibrium point.

Since any network starts from null, it can be imagined that the "chicken-and-egg problem" will always be an obstacle for any new network platform. If a network can find a way to bring in participants from at least one side of the market, the problem will be much easier to solve. One way of achieving this is to leverage on the installed customer base from other businesses of the platform owner. It will be relatively easier for the platform owner to convert these customers into participants of the network than starting from scratch. For example, when American Express started its charge card business in 1958, it leveraged on its existing global merchant network that were already accepting its traveler's checks. In the yellow directory business, telephone companies are the traditional and natural owners of the network because both sides of the market (consumer users/readers and the commercial users/merchants) are their existing clients. Thus the existing customer base in the telephony business is the valuable resource that enables telephone companies to create a large initial network of the yellow directory business.

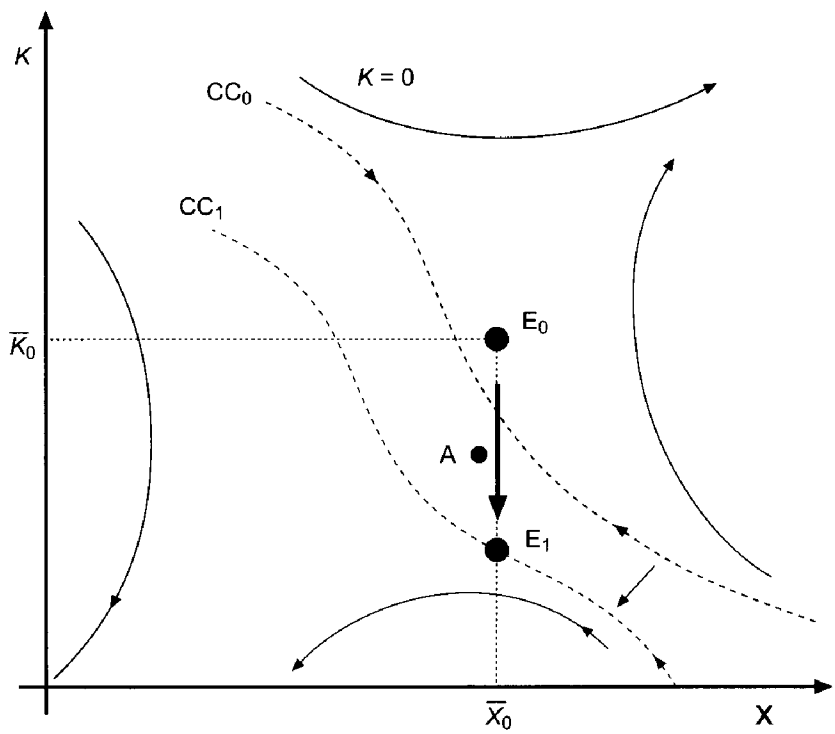
> Proposition 1: *To overcome the "chicken-and-egg" problem, firms entering two-sided markets as network platform owners should leverage on its existing networks or customer relationships from other businesses in order to boost the number of initial participants of the network.*

Pricing and product strategies

If a network cannot gather enough participants at the beginning, it may still achieve sustainable growth if it can substantially shift down the saddle path by adjusting product and pricing strategy. We can see from (5) that $(\overline{X}, \overline{K})$ is a function of the benefit, risk and fee parameters, which can be adjusted by the network owner. For example, $\overline{X}$ is increasing in z and f, and is decreasing in b. If the network owner reduces the membership fee z or provides more value b (say, increase purchase rebate in the credit card case) to consumer members, the equilibrium point will shift to the lower-left direction since $\overline{X}$ is now smaller. Because $\overline{K} = \frac{C_F}{q(r - C_F)}\overline{X}$, $\overline{K}$ will also be smaller. This means the equilibrium point and the saddle path will move toward lower-left which will expand the feasible region for sustainable network growth. Similarly, the network owner can also shift the equilibrium and saddle path lower by reducing the fees charged to merchants since $\overline{K}$ is increasing in C_F and C_V.

In Figure 3, the initial equilibrium point is E_0 and the saddle path is CC_0. A network starting at point A, which is below the saddle path, is unable to achieve sustainable growth. However, a reduction in C_F or C_V or both shifts the equilibrium point to E_1. The corresponding saddle path is CC_1. After reducing C_F or C_V, point A now lies above the new saddle path CC_1: reducing charges to merchants makes it possible for the network to achieve sustainable growth.

Figure 3
Shifting the Saddle Path



Besides lower pricing, the network sponsor can increase the value of the network to its participants (i.e. increase *b* and *r*) by providing added features or benefits to the existing network, which will also shift the equilibrium and the saddle path to the lower-left. For example, VISA provides free rental car collision damage insurance, 24-hour cardholder enquiry services, emergency cash disbursement and card replacement services to all of its cardholders free of charge. These features provide consumers extra incentive to join the network.

In addition, to reduce the potential risks of using credit card for payment, the network sponsor may also take actions to lower the value of *f*. For example, to reduce cardholders' worry about fraudulent transactions, VISA provides "zero liability on fraudulent transactions" to all of its cardholders. They also set up 24-hour hotline for cardholders to report and replace lost or stolen cards. All these services are free of charge. To prevent over-borrowing and potential personal bankruptcies, card network sponsors have categorized the cards into different types and worked with card issuers to assign different credit lines to different type of cards. For example, MasterCard has four types of credit cards: standard, gold, platinum, world. The credit limit of these cards varies from as low as a few hundred dollars (for standard and gold card) to no preset credit limit (for world cards). Such credit line management not only helps card issuers to control the credit risk, but also helps cardholders to spend within their financial capability.

> Proposition 2: *Platform sponsors of two-sided networks might overcome the "chicken-and-egg" problem by lowering price/fee, increasing the benefit and/or decreasing the potential risks faced by its participants.*

The drawback of these actions is the profit sacrificed by the network owner: reducing price/fee will lower revenue, and increasing benefits and/or decreasing potential risks will increase the cost of maintaining the network. However, such profit loss can be mitigated if the network owner reverses its pricing or product strategy after the network has reached a larger size. This is feasible because, with a larger network size, it can tolerate a higher saddle path now. Therefore, as the network grows larger, the network owner will have more flexibility in its product and pricing strategies and can enjoy higher profits than in its initial stage. For example, when Diners Club started their charge card business, they sent out cards to consumers free of charge. Soon after their business took off, they started to charge $3 (at 1949 price) annual membership fee.

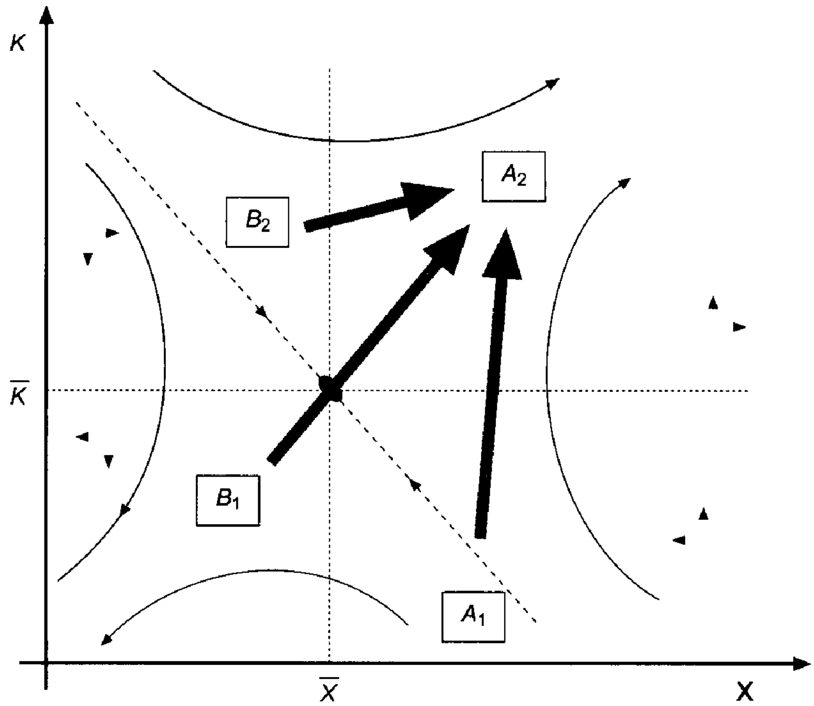
> Proposition 3: *Platform sponsors of two-sided networks can dynamically increase fees or lower the benefits it provides to network participants after the "chicken-and-egg problem" has been resolved.*

Merger & acquisition, licensing and alliance

If a network owner has little installed customer base to leverage on and has little room to adjust product and pricing strategies, it may overcome the "chicken-and-egg problem" by other means such as merger and acquisition, licensing or forming strategic alliance with other networks.

Merger & acquisition. Merger and acquisition between two small networks will help push the combined network beyond the saddle path. Therefore, the combined network will be able to achieve sustainable growth even though the two small networks could not do so individually. This is illustrated in Figure 4 as A_1 and B_1 merged into A_2, which lies in the sustainable growth region.

Figure 4
Effects of M&A. Licensing and Alliance
(Sustainable A_2, B_2; Unsustainable A_1, B_1)



Licensing or forming strategic alliance. Small networks might overcome the "chicken-and-egg problem" by forming strategic alliance among each other or obtaining license from a large network. By forming strategic alliance, small networks are linked together, which creates a larger network. This is illustrated in Figure 4 as the alliance between A_1 and B_1 leads to a larger network (A_2). By signing licensing agreement with a larger network, participants of a small network (licensees) can enjoy the large network of the licensor. The licensing agreement essentially combines the network of the licensor and licensees into one larger network. In Figure 4, the licensing agreement among the licensor network (B_2) and two licensee networks (A_1 and B_1) leads to a larger network (A_2).

Though merger and acquisition, licensing, and forming strategic alliance are effective approaches to overcoming the "chicken-and-egg problem", they also have drawbacks because network owners need either to pay premiums for merger and acquisition, royalties for licensing or to share the profits from the alliance network instead of enjoying the monopoly profits. In the licensing and strategic alliance cases, the licensees and all members of the alliance essentially give up their independent control over the individual networks and have to share the profits (e.g. the interchange fees in the credit card case) with other members of the alliance. In fact, they change their roles from independent network owners/ sponsors to just distributors of the combined network.

The interesting insight is that, even after taking these cost factors into account, strategic actions such as M&A, licensing and forming alliance may still be worth taking. The positive feedback across the two sides of the market suggests that any increase in the number of participants would trigger spiral increase in the value provided to all participants. This means that in two-sided markets, "1 + 1 > 2" holds true: strategic actions such as merger and acquisition, licensing and forming strategic alliance allows networks to exploit rents that are unexploited otherwise. Therefore, they are effective and mutually-benefiting ways of expanding network sizes in two-sided markets.

> Proposition 4: *Two-sided networks with insufficient participants from either or both sides of the market might overcome the "chicken-and-egg" problem through merger and acquisition, licensing or forming strategic alliance.*

Search/transportation cost

The positions of the equilibrium and the saddle path are also determined by the unit search and transportation cost t as is shown in (5): the lower the cost t, the lower the equilibrium and the saddle path, thus the easier for networks to overcome the "chicken-and-egg problem." As can be seen from (6), the search and transportation cost also affect the eigenvalues. It is easy to see that the dominant eigenvalue λ_1 is inversely related to t. Therefore, the lower the search and transportation cost, the higher the λ_1. Since the magnitude of λ_1 determines the speed at which the system converges to the dominant eigenvector, a lower search and transportation cost will also enable a faster growth of the network, if the network has already surpassed its saddle path. Therefore, even if a network has already overcome the "chicken-and-egg problem," lowering the search and transportation cost will still benefit the network by enabling it to grow faster.

To reduce the search cost, network sponsors can promote better information dissemination to cardholders on card acceptance. For example, both Diners Club and American Express regularly announce in the monthly statements sent to cardholders the names of merchants who have recently joined their network. VISA provides a directory of the merchants in its Interlink debit card network on its website. Cardholders can type in the merchant category and the location information on the website and search for all the merchants accepting VISA debit cards. Such information helps cardholders to reduce their search cost when they want to shop with the card.

The proliferation of the internet also provides platform owners significant opportunities to reduce cardholders' search and transportation cost. As web retailing gets more and more popular in the United States and around the world, the use of credit cards becomes essential for consumers shopping online. Since online shopping saves transportation cost both in terms of money and shopping time, enabling card acceptance by online merchants will help a card network to shift down its saddle path and/or increase the diffusion speed. In view of the importance of enabling credit card payment for online shopping, all of the four major card networks in the U.S. have been working hard to promote online payment. They not only invest heavily in the technology to ensure the security of online shopping, but also encourage cardholders to shop online by providing added security features as well as more information on web retailers. For example, to protect online shopping security, VISA provides a special program called "Verified by VISA." VISA cardholders can go to the VISA website and enroll in the program. They will be asked to create personal passwords for future online shopping at participating online stores. To find those online stores in this program, VISA provides a website where cardholders can easily search for participating stores either by their names or by merchant category. Such program promotes online shopping and reduces cardholder's search and transportation cost.

> Proposition 5: *To overcome the "chicken-and-egg problem" and/or increase the growth rate, two-sided networks should leverage on the new information technology and internet to reduce participant's search/ transportation cost.*

Advertising, marketing and promotion

A close look at the equilibrium point in (5) reveals the absence of the diffusion parameters α, β. This is means that changes in these parameters, which are affected by advertising, marketing and promotion as well as by the number of distributors, do not have any impact on the position of the equilibrium. However, these parameters should affect the growth rate of the network as can be seen from the dynamic equations (3) and (4). It can be intuitively imagined that, as α, β increases, the system will grow faster if it has already surpassed the saddle path (or shrink faster if it starts below the saddle path). Actually, this can be formally proved by showing that the dominant eigenvalue of the linearized system λ_1, which governs the speed of diffusion along the dominant eigenvector, is positively related to the diffusion parameters α, β (see appendix for the mathematical proof).

Since the diffusion parameters are affected by advertising, marketing and promotion, higher efforts on advertising and marketing promotion will enable a network to grow faster. This may explain why all payment card networks have been spending huge amount of money on advertising, marketing and promotion. For example, VISA U.S.A. spends about 20% of its operating revenue on advertising, marketing and promotion, which amounts to more than $500 million in 2005 (VISA, 2005). This was also why VISA started a decade-long series of marketing campaign in 1985 to inform the public that VISA cards were accepted by more merchants than American Express cards. They used the following slogans in the campaign: "VISA. It's everywhere you want to be" and "they don't take American Express" (Evans & Schmalensee, 1999, pp.185-188). Such advertising increased VISA's diffusion speed by mitigating the impact of incomplete information on network adoption.

Marketing promotions also reduce people's adoption inertia by providing stronger incentives for people to join the network. For example, credit card issuers have been using direct mails and online application methods to make it convenient for potential cardholders to apply for the card. The solicitations usually include "pre-approved" or "pre-selected" offers with specified "up-to credit limits" to mitigate consumer's inertia to application due to potential failure to approval. Many credit card issuers also provide a variety of one-time "sign-up bonus" for new cardholders. These incentives include instant cash back, sign-up reward points, sign-up gifts such as DVD players, etc. Such incentives have played an important role in attracting new cardholders. As network platform sponsors, both VISA and MasterCard have been providing support to card issuers in these marketing activities.

> Proposition 6: *To increase the growth rate of the network, two-sided networks may resort to advertising, marketing and promotion to mitigate the impact of incomplete information and inertia to adoption.*

The role of distributors

Another factor that affects the diffusion parameters is the number of distributors of the network. A network with more distributors will no doubt diffuse faster because the collective efforts made by the distributors to sign up merchants and consumers not only reduce people's inertia to adoption but also reduce the technical barriers to diffusion. In many cases, the technical barriers are lowered simply because these distributors have access to a larger population pool from their local bank customers, more merchants can be covered by their local banks, and card applications are easier to be approved if the applicants have had a relationship with the issuing banks.

The important role of distributors can be seen from historic cases. In 1960s, American Express was the leading payment card network in the U.S. payment card industry. It has been the sole distributor (i.e. issuer) of its own network platform until 2004. On the other hand, when VISA and MasterCard were formed in 1966, both had multiple issuing banks or distributors. They have been allowing more and more distributors to join their networks ever since. The collective efforts of these distributors made differences over time. As of 2000, VISA and MasterCard captures 50% and 26% of the US market share in terms of card volume while American Express only has 17% [3]. If American Express had allowed other banks to issue its proprietary card, its market share today could have been much larger.

In view of the limitation of the "single-distributor" network, American Express changed its business model in 2004 and started to allow other issuers to issue American Express cards. MBNA became the first third-party issuer of American Express card in 2004. Other banks such as Bank of America and Citibank have also followed suit in 2005 and 2006. With more and more distributors of its card network, we can expect to see a faster growth of the American Express card network in the years to come.

Proposition 7: *To increase the rate of network growth, two-sided network platform sponsors should allow and encourage third-party distributors to distribute its network.*

A Case Study: The U.S. Payment Card Industry

In the United States, payment card is one of the most important payment instruments for consumers. According to the Federal Reserve Board, about 70% of the U.S. households have at least one payment card in 2001. The volume of credit and debit card transactions amounted to $1.8 trillion in 2002, 60% higher than transactions paid in cash. At the end of 2004, Americans carried more than 1.4 billion payment cards, which is equivalent to 5 cards per person or 15 cards per household[4].

In the following subsections, we provide a history of the U.S. payment card industry[5] which provides empirical supports to the insights from our dynamic model.

Charge account programs: Extremely limited acceptance

In early twentieth century, merchants (including stores, restaurants, oil companies, etc.) started to set up charge accounts for their frequent patrons. These accounts provided payment convenience to their customers, which helped merchants to generate more sales. However, from consumer's perspective, a charge account was useful only with a particular merchant. If a consumer wanted to enjoy the payment convenience in other stores or restaurants, she had to set up a separate charge account with each of them. In other words, the acceptance of a charge account is extremely limited. In the framework of two-sided market, there is only one merchant on one side of the market while there are multiple consumers on the other side. Such a network cannot achieve sustainable growth due to its small and skewed size.

Diners Club: Starting from scratch

In 1949, Frank McNamara, Ralph Snyder and Alfred Bloomingdale launched Diners Club in New York city by giving away free charge cards to consumers and singing up restaurants in downtown New York. The card allowed cardholders to enjoy the benefit of charge accounts with several restaurants without setting up accounts individually. This small improvement in merchant acceptance brought instant success to Diners Club. Inspired by the rapid business growth in New York, Alfred Bloomingdale started another card operation in Los Angeles, California. They soon decided to merge these two operations together and also expanded to Boston by acquiring a similar operation there. Within a year, Diners Club had signed up 285 merchants and acquired 35,000 customers. By the end of 1951, the annual charge volume had reached $6.2 million (Mandell, 1990, pp.1-10).

Initially, Diners Club made money only from the 7% merchant discount (based on purchase volume), which is the same as the fees that restaurants paid to travel agencies for bringing travelers to them. It did not charge cardholders. Soon after they saw their business on a healthy growth track, they started to charge a $3.00 annual membership fee. The membership fee did not stop customers from applying for the card. With a nationwide network (though only in three cities initially), Diners Club cards were appealing to many business travelers who didn't want to carry too much cash. As Diners Club expanded its business to hotels, retail stores and other lines of business, its merchant acceptance grew larger and larger. Consumers who cared more about convenience were willing to pay the membership fee as merchant acceptance increased.

The success of Diners Club shows that a network starting from scratch could achieve sustainable growth by appropriately setting its pricing strategy. Recall the equilibrium point in (5), the initial zero membership fee strategy significantly lowered the equilibrium number of merchants ($\overline{X}$). More importantly, since there was no fixed cost to merchants (i.e. $C_F = 0$)[6], the equilibrium $\overline{K}$ is zero. This means that the equilibrium point lies on the X axis in the phase diagram which, together with a small $\overline{X}$, made it easy for Diners Club to push itself above the saddle path and achieve sustainable growth.

Diners Club's practice also supports Proposition 3: it increased fees to cardholders once it gathered enough momentum for growth. The benefit from merging Diners Club and the other two card networks in Boston and Los Angeles provides empirical evidence for Proposition 4[7].

Early bank followers: Small local networks

The success of Diners Club attracted a lot of other businesses into the payment card business. Between 1953 and 1954, nearly 100 banks introduced their own card plans, mostly for their own customers and within their local areas. However, most of them quitted the business shortly because the small-scale operations could not attract large enough participants to make the business profitable. Since U.S. banking regulations prohibited banks from setting up out-of-state branches at that time, it was hard for banks to sign up merchants and cardholders in other states. As a result, their merchant networks were limited to local areas and cardholders couldn't use their cards when traveling out of the state. Even within local territory, those cards were only accepted by small retail stores without charge account systems. Big department stores rejected third party credit cards because they had their own charge card systems and didn't want third party cards to intrude their territories. The failures of these early banks in their card operations provide strong evidences of the "chicken-and-egg problem" in the payment card industry.

American Express: Creating a large initial network

In 1958, American Express entered the charge card business. Before that, American Express had been in the travel and entertainment business since 1850. Its traveler's checks, invented in 1890, were accepted globally. When it entered the charge card business, the first step it took was to acquire the Universal Travel Card plan issued by the American Hotel Association, which contributed 4,500 merchants and 160,000 cardholders to American Express' card operation. In addition, it put great efforts in signing up more merchants and marketing the card to consumers, especially by leveraging its existing travel-related network. Within the first year of operation, it had already acquired 32,000 merchants and 475,000 cardholders. By 1976, American Express had become number one card issuer with 6.3 million cardholders, well above Diners Club which had only 837,000 cardholders in the United States. By 1977, American Express's sales volume had reached $8.3 billion which was ten times higher than Diners Club.

The quick takeover of market leadership by American Express from Diners Club showed the impact of network effect: a large initial network could lead to spiral growth in the future. With a larger initial network, American Express charged 20% higher annual membership fee to cardholders than Diners Club without affecting the sustainable growth of its network. This is because the large initial network enabled it to lie above a higher saddle path than Diners Club. The acquisition of the Universal Travel Card plan provides another empirical support to Proposition 4.

BankAmericard: A true "credit" card

In the same year that American Express entered the card business, Bank of America (BOA), then the largest bank in the U.S., also jumped onto the bandwagon. Though BOA was not the first bank entering the credit card business, it was the first one that succeeded in that business. In contrast to other banks' card operations which failed to grow due to the federal ban on interstate branch banking, Bank of America's was less affected by the regulation because of the geographical nature of California where Bank of America operated. Since BOA had a large branch banking network in California, one of the largest states in the U.S., BankAmericard was accepted over an extensive, well-traveled area. This made its card valuable to many cardholders. Furthermore, unlike Diners Club and American Express cards, BankAmericard was a true "credit" card in the sense that it allowed cardholders to revolve the balances after the grace period. This additional attribute made its credit cards more valuable to consumers who need convenient debt financing for a longer maturity. Using our dynamic model framework, such a feature corresponds to a higher value of b for BankAmericard than the charge cards issued by Diners Club or American Express, which lowered the equilibrium $(\overline{X}, \overline{K})$ and the saddle path and made it easier for BankAmericard to overcome the "chicken-and-egg problem."

VISA: Evolution from licensing

Realizing that a large initial network size was the key to overcoming the "chicken-and-egg problem," a few small banks asked Bank of America to license BankAmericard to them. By issuing BankAmericard, these small banks could enjoy a much larger network: their cardholders could get access to the BankAmericard merchants, and the merchants they signed up could capture incremental sales from more BankAmericard holders. Since the licensing agreement essentially expanded the existing BankAmericard network, it also benefited BOA. In 1966, the licensing agreement was reached and a national merchant network was created for BankAmericard (Chutkow, 2001, pp. 69-70). Thus the "chicken-and-egg problem" is no longer an issue to the licensee banks.

The positive cross-group network externalities between cardholders and merchants propelled the growth of the BankAmericard network. By 1970, more than 900,000 merchants were accepting the BankAmericard. Such rapid growth made licensing a less appropriate format for running the network because licensee banks wanted to exert more influences on the development of the network. Under the pressure from the franchisees, Bank of America spun off its BankAmericard operation in 1970. A new organization, called National BankAmericard, Inc. (NBI), was formed as an independent association of the member banks. In 1976, NBI changed the name of BankAmericard to VISA. Since then, the VISA network has enjoyed exponential growth with merchant acceptance rising from about 2 million in 1980 to more than 4 million in 2001, and the number of VISA cards in circulation rising from 60 million to 360 million.

MasterCard: Alliance among member banks

When Bank of America started to license BankAmericard to other banks in 1966, a few other U.S. banks viewed it as a threat to their individual card networks. They reacted immediately by merging their card networks and launched the Interbank Card Association (ICA) to compete against the BankAmericard network. Similar to the BankAmericard licensing arrangement, the founding of ICA created a national payment card network through which the cards issued by any member banks could be accepted by merchants signed up by other members. In 1969, ICA bought "Master Charge" brand from Western States Bank Card Association in order to create a unique identity for its card. In 1979, ICA changed the "Master Charge" brand to "MasterCard." The history of MasterCard provides another empirical support to Proposition 4.

Discover card: A successful latecomer

By mid-1980s, the U.S. credit card industry had become fairly mature. By 1988, merchant acceptance for bankcards (i.e. VISA and MasterCard) has reached 2.5 million in U.S. and 5.9 million worldwide. American Express cards were accepted by 1.4 million merchants in U.S. and 2.1 million worldwide. Given such large existing networks and strong network effects in this market, it was hard to imagine that a newcomer could successfully launch a new card. However, in 1986, a new proprietary card network was launched by Sears Roebuck & Co. This was the Discover Card.

Before Sears launched the Discover card, it already had its own store card, which was accepted only by Sears stores. With 55 million store card accounts, Sears was already the largest issuer of credit cards in the world in 1986. After its acquisition of Coldwell Banker and the Dean Witter brokerage company in early 1980s, Sears saw the launch of a universal credit card as an important opportunity to expand its financial services. Through Greenwood Trust Company, a Delaware-based bank owned by Sears, Sears launched its proprietary Discover card in 1986.

When Discover card was first introduced, there were lots of suspicions on its viability. Given the large existing payment network of VISA, MasterCard and American Express, and given the well known "chicken-and-egg problem" in this market, it was natural for industry analysts to doubt the fate of the Discover card[8]. However, Sears seemed to have already realized these issues and took corresponding actions. First, it leveraged on Sears store network and made Discover card accepted by its own stores nationwide. Second, to enlarge the initial network size, it signed up 75,000 merchants, including American Airlines and Holiday Inns, even before the official launch of Discover card. Third, it set a low pricing strategy on the merchant side and charged lower merchant discount (i.e. lower C_V in the dynamic model) than other card networks in order to persuade merchants to accept the Discover card. Fourth, it also set a low price on the consumer side and charged no membership fee (i.e. $C_F = 0$ in the model). Fifth, it offered up to 1% purchase rebate to cardholders, which is equivalent to a higher b in the dynamic model.

As predicted by our model, all these strategies helped Discover to overcome the "chicken-and-egg problem." Even though the initial merchant base of the Discover card was significantly lower than the other three card networks, it was large enough to generate the momentum for sustainable growth. By the end of the first year of operation, Discover card had more than 12 million cardholders and was accepted by 550,000 merchants. By the end of the second year, its customer based had grown to 22 million, representing 5% of market share.

The growth of the Discover card network translated to significant profits. Though Sears lost $106 million on Discover card in its first year of operation due to high marketing cost, it turned into profitability in 1988 ($19 million), 1989 ($80 million) and 1990 ($117 million)[9]. After two decades of operation, Discover[10] has become a solid player in the payment card industry in the U.S. Its success indicates that a latecomer could still succeed as a network platform owner in a two-sided market if it follows appropriate strategies as specified in this paper.

Conclusion

Using a simple dynamic system model, we study the growth dynamics of payment card networks in a two-sided market framework. In particular, we show how the "chicken-and-egg problem" is created by the cross-group network effect and what strategies can be used to overcome the problem. In summary, network platform owners could leverage its existing networks or relationships with either side of the market, resort to merger and acquisition, licensing or strategic alliance, adjust product and pricing strategies and reduce search and/or transportation cost to overcome the "chicken-and-egg problem." In addition, they may also leverage on advertising, marketing and promotion as well as allowing and encouraging third-party distributors of its network to increase the speed of network growth. We use the U.S. payment card industry as an empirical background to support to our findings.

The dynamic model in this paper describes the growth of an independent two-sided network. Since we are concerned with the "chicken-and-egg problem" faced by any two-sided network even without facing competition, the impact of competition is not explicitly modeled in this paper. Sun & Tse (2006) provide a linear dynamic system model which involves network platform competition in two-sided markets. Their research goal is to understand whether winners will take all in two-sided markets. They find that in certain two-sided markets where individual participants tend to join only one network, though different individuals may join different networks, only one network is likely to survive in the long-run; when individual participants tend to join multiple networks, multiple networks may co-exist as long as each of them can surpass their own saddle paths. The latter findings resemble what we find in this paper while the former findings indicate that the conditions for networks to survive are even more stringent when competition effects are combined with the "chicken-and-egg problem."

Though the model in this paper best reflects the payment card industry, the insights from the model are also applicable to a wide variety of two-sided markets where there is congestion effect on one-side of the market. For example, the PC operating system (OS) is a two-sided network where PC users and software developers represent the two sides. On the software developer side, there are congestion effects because developers compete against each other for software sales. On the PC user side, the congestion effect is absent. In this market, we see Dell, Hewlett-Packard and Gateways as third-party distributors of Microsoft Windows system and Apple as the sole distributor of its Macintosh system. The slower growth of the Macintosh system as compared to the Windows system in the past two decades also reflects the important role of third-party distributors. Since similar market structure also exists in the video game console markets, the VCR format networks, yellow directories, etc., network growth dynamics and insights from this paper can be applied to these two-sided markets as well.

Appendix

Proof of the Relationship between λ_1 and the Diffusions Parameters of α,β

Proof: We need to show that $\frac{d\lambda_1}{d\alpha} > 0$ and $\frac{d\lambda_1}{d\beta} > 0$.

$$\frac{d\lambda_1}{d\beta} = \frac{d}{d\beta}\left\{\frac{[q(b-f)-z]\left[-\alpha C_F + \sqrt{\alpha^2 C_F^2 + 4\alpha\beta q(r-C_P)[q(b-f)-z]}\right]}{2t}\right\}$$

$$= \frac{[q(b-f)-z]}{2t} \times \frac{4\alpha q(r-C_V)[q(b-f)-z]}{2\sqrt{a^2 C_F^2 + 4\alpha\beta q(r-C_P)[q(b-f)-z]}}$$

$$= \frac{\alpha q(r-C_P)[q(b-f)-z]^2}{t\sqrt{\alpha^2 C_F^2 + 4\alpha\beta q(r-C_V)[q(b-f)-z]}} > 0$$

$$\frac{d\lambda_1}{d\alpha} = \frac{d}{d\alpha}\left\{\frac{[q(b-f)-z]\left[-\alpha C_F + \sqrt{\alpha^2 C_F^2 + 4\alpha\beta q(r-C_P)[q(b-f)-z]}\right]}{2t}\right\}$$

$$= \frac{[q(b-f)-z]}{2t} \times \left[-C_F + \frac{2\alpha C_F^2 + 4\beta q(r-C_V)[q(b-f)-z]}{2\sqrt{\alpha^2 C_F^2 + 4\alpha\beta q(r-C_P)[q(b-f)-z]}}\right]$$

Since $\frac{[q(b-f)-z]}{2t} > 0$ by assumption, we only need to check the sign of the second term:

$$-C_F + \frac{2\alpha C_F^2 + 4\beta q(r-C_V)[q(b-f)-z]}{2\sqrt{\alpha^2 C_F^2 + 4\alpha\beta q(r-C_V)[q(b-f)-z]}}$$

$$= -C_F + \frac{2\alpha^2 C_F^2 + 4\beta q(r-C_V)[q(b-f)-z]}{2\alpha\sqrt{\alpha^2 C_F^2 + 4\alpha\beta q(r-C_V)[q(b-f)-z]}}$$

$$= -C_F + \frac{\alpha C_F^2}{2\sqrt{\alpha^2 C_F^2 + 4\alpha\beta q(r-C_V)[q(b-f)-z]}} + \frac{\sqrt{\alpha^2 C_F^2 + 4\alpha\beta q(r-C_V)[q(b-f)-z]}}{2\alpha}$$

$$=\frac{1}{2}C_F\left[\frac{\alpha C_F}{\sqrt{\alpha^2C_F^{\,2}+4\alpha\beta q(r-C_V)[q(b-f)-z]}}-1\right]+\frac{1}{2}\left[\frac{\sqrt{\alpha^2C_F^{\,2}+4\alpha\beta q(r-C_V)[q(b-f)-z]}}{\alpha}-C_F\right]$$

$$=\frac{1}{2}C_F\left[\frac{\alpha C_F}{\sqrt{\alpha^2C_F^{\,2}+4\alpha\beta q(r-C_V)[q(b-f)-z]}}-1\right]+\frac{1}{2}C_F\left[\frac{\sqrt{\alpha^2C_F^{\,2}+4\alpha\beta q(r-C_V)[q(b-f)-z]}}{\alpha}-1\right]$$

$$=\frac{1}{2}C_F\left[\frac{\alpha C_F}{\sqrt{\alpha^2C_F^{\,2}+4\alpha\beta q(r-C_V)[q(b-f)-z]}}+\frac{\sqrt{\alpha^2C_F^{\,2}+4\alpha\beta q(r-C_V)[q(b-f)-z]}}{aC_F}-2\right]$$

Let $\frac{\alpha C_F}{\sqrt{\alpha^2C_F^{\,2}+4\alpha\beta q(r-C_V)[q(b-f)-z]}}=\sqrt{\frac{\alpha^2C_F^{\,2}}{\alpha^2C_F^{\,2}+4\alpha\beta q(r-C_V)[q(b-f)-z]}}=\sqrt{w}$

then

$$-C_F+\frac{2\alpha C_F^{\,2}+4\beta q(r-C_V)[q(b-f)-z]}{2\sqrt{\alpha^2C_F^{\,2}+4\alpha\beta q(r-C_V)[q(b-f)-z]}}$$

$$=\frac{1}{2}C_F\left[\frac{\alpha C_F}{\sqrt{\alpha^2C_F^{\,2}+4\alpha\beta q(r-C_V)[q(b-f)-z]}}+\frac{\sqrt{\alpha^2C_F^{\,2}+4\alpha\beta q(r-C_V)[q(b-f)-z]}}{\alpha C_F}-2\right]$$

$$=\frac{1}{2}C_F\left[\sqrt{w}+\frac{1}{\sqrt{w}}-2\right]$$

$$=\frac{1}{2}C_F\left[\frac{w+1-2\sqrt{w}}{\sqrt{w}}-2\right]$$

$$=\frac{1}{2}C_F\left[\frac{(\sqrt{w}-1)}{\sqrt{w}}\right]>0$$

Therefore $\frac{d\lambda_1}{d\alpha}>0$

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Footnotes

[1] We assume an infinite population to avoid the boundary conditions. This is a proxy of the real world cases where the population of consumers and merchants is very large from a network owner's perspective.

[2] We are grateful to an anonymous reviewer who pointed out these potential risks.

[3] Source: VISA USA website http://www.usa.visa.com/about_visa/newsroom/statistics.

[4] Source: CardData (www.carddata.com), Feb. 25, 2005.

[5] Payment cards include credit card, charge card and debit card.
[6] There was no equipment investment on the merchant side for joining Diners Club network at that time, unlike today when merchants need to purchase electronic equipment in order to be linked to the electronic payment system.
[7] Diners Club was acquired by Citicorp in 1980.
[8] For example, an article in Wall Street Journal (Eastern edition) on February 10, 1988 wrote: "The Discover card, Sears, Roebuck & Co.'s brash effort to take on Visa and MasterCard, is in danger of joining the Edsel and New Coke in the lineup of great product disasters" (Bailey, 1988).
[7] Since Sears is both the owner of the Discover card network and a card issuer, its profit came both from the merchant discount and from the finance charges to cardholders on their revolving balances.
[8] In 1993, Dean Witter, Discover & Company went public. In 1997, Dean Witter, Discover & Company merged with Morgan Stanley. So Discover Card Services is a part of the Morgan Stanley Dean Witter today.

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