Re-examining Network Market Strategies from the Perspective of the Local Network: Market Competition between Incompatible Technologies

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Abstract

Much of work on network externality assumed network effects are dependent on the network size. Therefore, very little consideration is given to the view that marginal benefits from joining the network may not increase with the network size if consumer benefits come from the direct interaction with neighbors, namely **local network**. In this study, we used the agent-based simulation method to re-examine the effectiveness of the traditional network market strategy under the presence of the local network where two incompatible technologies compete. We found that the strategy of growing an initial customer base is not effective under the presence of the local network. Our study also showed that targeting customers based on their technology preference is not as effective as targeting customers within the same local network. As a result, the focus of a network market strategy should be directed to taking advantage of the customer network.

Keyword: Network Externalities, Network Effect, Network Structure, Agent-based Simulation, Product Introduction Strategy

1. Introduction

Practitioners and academic scholars have paid keen attention to the exploitation of the network externality because it has been regarded as the source of making a product more valuable to potential buyers with the growth of the network [9, 10 13, 14]. As a result, it leads to a lock-in to a certain technology involving a larger customer base [2]. Recent technological advances in the Internet and a variety of businesses based on the Internet open more chances to take advantage of network externality as manifested in recent proliferation of online communities [23].

However, there has been criticism of the characterization of network externality, especially the determination of network externality by the network size. Notably, Liebowitz and Margolis [16] criticized the specific assumption about the change of marginal network benefits on the customer side.

The marginal network effect was simply assumed to be constant or increasing with respect to the size of network as manifested in the so-called Metcalfe's law. However, they argued that the 'true' network effects in the customer side are more likely to be determined by the local network, not by the entire network, because people are concerned more with those who really interact directly with them when they decide to make a purchase. Under this framework, marginal network effects are increasing but limited within a local network of direct interaction. Their research implied that the network effects can be broken down into two parts in terms of where they come from: one is the network effects from the entire network mainly caused by the network size (indirect effect), and the other one is caused by the change of the local network such as the customer network (direct effect). We coined the network whose effects are determined by the entire network size, as the global network because a change in the network affects all other agents without being affected by its structure in contrast to the case of the local network. However, Liebowitz and Margolis [16, 17] conducted no explicit analysis to exhibit the impacts on the market outcome under the presence of the dual network framework.

The objective of our study is to exhibit how the model based on the dual network structure on the customer side may change the market outcome. In addition, we suggest that the network market strategy under the framework of prior studies may be misleading or over-stated under the presence of the local network, and we provide the way of enhancing the market strategy by exploiting the local network property. Under the local network, the unit of analysis is the relationship between individuals within the local network [21]. The number of relations increases exponentially with the number of individuals [26]. Thus, to conduct the analysis of a local network, an analytical study can hardly be possible [18, 26]. We relied on the agent-based simulation method for analyzing complex behavior of many interactions.

What we mainly found is that the market under the local network tends not to be as tippy as prior studies asserted. As the size of the local network approaches that of the global network, the market shows the clear sign of monopoly as much prior work indicates. We also showed that a large market share or the build-up of a large customer base can be misleading to the belief that the firm will dominate the market. Thus, we argued that a traditional market strategy in the network market should be reconsidered to incorporate the property of the local network. We suggest that the creation of a customer *cluster* is an effective way of building up an installed base by exploiting the local network.

In the next section, we will review studies on network externality. Section 3 will explain the model we employed to represent the local network structure. Section 4 will show the simulation results and we will discuss the implication of our results. The conclusion and further studies follow in the ensuing section.

2. Literature Review

Much prior work on the network externality constructed a model where the adoption decision was affected by the increased benefits from the growth of the network [2, 4, 9, 10, 13, 14, 23, 25]. Under this assumption, the firm with a larger installed base always takes a stronger position in the market based on the demand-side scale economy [23]. Farrell and Saloner [13, 14] depicted the effect of network externality as the source that inhibits the market selection of the new and superior technology in the market with network externalities. They called this undesirable market selection of an inferior technology as 'excess inertia'. Arthur [2] conducted the dynamical analysis of the network market competition using computer simulation. He argued that the network market has a path-dependent characteristic so that a small advantage in market share create a self-reinforcing momentum to make the difference in market share bigger, thereby leading to a dominant winner. Theoretical studies have put more emphasis on exhibiting the lock-in phenomena caused by network externalities and showing a socially undesirable selection of a market standard.

Empirical network studies have focused on confirming whether a consumer is willing to pay more for a product if it is compatible with a large network especially in Information Technologies [3, 8, 11, 12, 22]. These studies found out that the price premium and the installed base have a positive relationship.

However, we have not seen ample evidence of the undesirable selection of inferior technology as a standard caused by network externality, though market failure is frequently referred to as a characteristic in the network market. The network can be a physical network such as telecommunications and 'metaphorical network' such as users of various products [16]. Thus, we expect market failure to happen in many industries. However, few network products except the keyboard [6] and the VCR [23] has been given as evidence of market failure. However, this so-called 'evidence' is also bitterly challenged by Liebowitz and Margolis [17] because of the lack of factual grounds for *better* quality.

Liebowitz and Margolis [16] also criticized the concept of network externality used in other studies. First, they argued that network externalities as market failure are theoretically fragile and empirically undocumented. They noted that the effects of the change in the network size include not only the network benefits in the demand-side market but also positive or negative impacts on the other economic agents. Therefore, the network externality on the demand side should be regarded as a special kind of network effect. However, the network externality on the demand side has been regarded as the source of market failure, though the network effects caused by the size increase are not restricted to the demand side. Second, they criticized many previous studies that have no specific assumption about whether marginal benefits of network effects are increasing or not. Further, they articulate that network benefits are confined to customers who really interact. Network externality grows not with the entire network size but with the size of the number of neighbors one has. Consumers communicate and share information more with a small subset of the market and they exchange learning on how to use a technology via a localized information network [5]. Therefore, it is necessary for us to make a distinction between network effects affected by the global network and network externality affected by the local network. However, Liebowitz and Margolis [16] implied the presence of a local network in their study but did not conduct a systematic analysis putting an emphasis on network benefits within the local network. Besides, there was no attempt to compare the market outcome under the local network with the one under the global network. Thus, it is our research objective to fill this void.

There have been several studies on the local network pertaining to the process of reaching a market standard [1, 5, 7]. They emphasized the dynamics of coordinating behavior of the members in the local network and exhibited how the market evolves into a standard. Cowan and Miller [5] conducted the analysis of emerging market behavior under local influence. They employed the simple decision rule - each individual's choice is determined by the choices of neighbors. They found that decentralized behavior in the local network can lead to the emergence of a standard, but it also can result in a variety of equilibriums. Our study will elaborate the behavioral aspect of consumers under the local network and explore how the market evolves.

Since we are interested in a customer's interaction with the network, the network relationship is determined by the *chains* of local networks. It appears to be hardly possible to conduct an analytical analysis of exponentially increasing the number of relations of especially heterogeneous agents [18, 26]. So our analysis is based on the computer simulation to track the dynamic patterns of the emergent market with competing technologies, especially under the presence of the dual network structure.

3. Model

The importance of the network structure on the adoption of a product has been found in diffusion studies. Strogatz [24] noted that structure always affects function, which means the structural properties of the network have definite impacts on the diffusion of information. Watts' studies [26] also argued that the structural property of the network may improve the information diffusion. He suggested the key characteristic parameter to describe the structural difference of the social network and its capability to disseminate information.

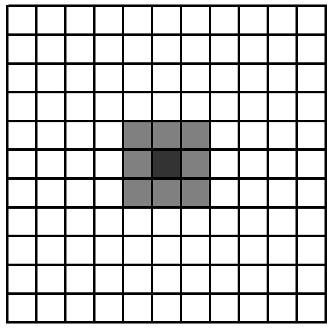
We employed the concept of the global network, which has been implicitly assumed in much of prior work, and the local network, which was also noted by Liebowitz and Margolis [16]. The structure of the global network can be interpreted into the perfectly connected network structure, where every agent has physical or metaphorical links with everyone else in the entire network. The link between consumers is the relation that generates network effects. Therefore, under the global network, the adoption of one consumer increase network benefits of all other consumers in the market because that consumer has links with all other consumers in the market. Prior network studies modeled the network benefits determined by the entire network size denoted as n. As a result, as new adoption occurs and n increases to $n+1$, it affects the network benefits of the current and prospective consumers in the market. Thus, much of prior work was implicitly built upon the global network structure.

By contrast, the consumer in the local network has less number of links than in the global network. As Liebowitz and Margolis [16] asserted, a consumer considers those who really interact when she think of buying the network product. The number of those who really interact is much smaller than that of the global network. The number of her links is definitely smaller than the global network.

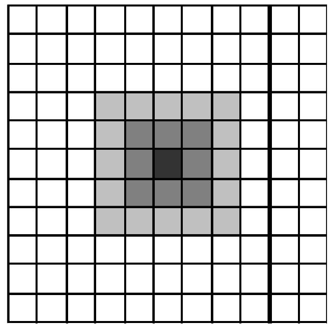
To incorporate the two network structures, we employed Cellular Automata, which has been a tool for investigating the complex behavior of interacting agents. Wolfram first introduced this concept into the analysis of complex systems exhibiting the emergent behavior caused by the interactions between large numbers of agents [19]. Its well-known structure is a two-dimensional grid with cells that have status represented by numerical value. A cell's status is determined by the status of its neighboring cells.

We built our network structure in a two-dimensional lattice (n x n). Each cell represents an individual customer. All customers have a certain number of neighbors and therefore, they have their local network consisting of their neighbors. The number of neighbors per customer determines the size of the local network. We introduced *k*, defined as the ratio of the size of the local network with respect to the entire network size. As *k* grows, the local network size becomes bigger. At $k = 1$, the market becomes the same as the global network. This is advantageous in that this model structure allows a variety of the local network including the global network as a special case by varying the value of *k*. The Figure 1a, 1b illustrates the change of the size neighbors.

Figure 1. The Change of the Size of Neighbors in the Local Network



1a) 8 Neighborhoods



1b) 24 Neighborhoods

We employed much of Arthur's model [2] in constructing the demand side in our study. Arthur [2] first conducted a dynamic analysis of the network market competition under the influence of network effects by the simulation method. Our analysis incorporated the local network structure into Arthur's model to exhibit its influence.

In our model, there are two incompatible technologies, denoted as A and B. Initially, we restricted our analysis to consumer network effects. Therefore, the strategic moves by firms such as exploiting the network or promoting the product are not incorporated. Later, we extend our analysis to the firm's strategy for network competition.

Consumers are assumed to be heterogeneous in terms of their basic preference for two products. We assumed two types of consumers, R and S type, following Arthur's model. The R type agent has high basic preference for technology A product but low preference for B product. The S type agent has higher preference for technology B than A. In general, they follow their intrinsic preference when they choose a technology under no influence of network effects. As the number of adopter increases within one's local network, a potential adopter is sometimes compelled to choose a less preferred technology, primarily by the increased network benefits. In contrast to Arthur's study, the network benefits are realized not by the entire market size but by the number of adopters within one's local network.

The consumer utilities assumed in our study are made up of network-related and network-independent benefits, which have been frequently used in other studies on network externalities [9, 10, 13, 14]. The utility function for two types of the consumer is as follows

$$U_{At} = a + rn^{*}_{At} \qquad (1)$$

$$U_{Bt} = b + rn^{*}_{Bt} \qquad (2)$$

A consumer makes a product choice, which gives more benefits, by comparing the utilities of two incompatible technologies. Our focus is confined to the network benefits only created within the local network structure. Therefore, in contrast to Arthur's study, network effects are modified to employ the benefits arising within the local network. Thus, we assumed that the size of the network, n_A and n_B denote the number of one's neighbors that join in a certain technology network rather than the entire network sizes of technologies. In order to confine the influence of the presence of the local network on the market outcome, we assumed all consumers have the same number of neighbors. This can be relaxed to allow each consumer to have different number of neighbors but it complicates the analysis by introducing the other factor and makes little contribution to what we intend to show.

The network-independent benefits are the consumer utilities of which size is determined by her basic taste or preference for a produce regardless of the network growth. In the utility function, a , b denotes the preference for technology A and B. The value of a , b is different for each agent as mentioned before. As a result, without network effects, the market share of two incompatible products are primarily determined by the distribution of the customer preference. We set the same number of each type agent in our experiment to exclude the influence of the preference distribution on the simulation result. The definition of utility functions is provided in the Appendix.

We developed the model enabling consumers to switch when they recognize better choice, giving more benefits. We assumed that the life of two products is one period respectively. Therefore, for every simulation period, the consumer decides to continue to use the current product or switch to the other product. When the benefits from using the current product become lower than those of the other product, she will migrate to the other one.

Including Arthur [2], many theoretical studies on network externality assumed that a consumer buys a life-long durable good and she makes no repeat purchase. In our study, the consumer utilities change over time denoted as *t* in the utility function. The changed utilities trigger consumers to migrate to the product with higher utilities. We assumed that the consumer preference is consistent and as a result, the change in the utilities and the following migration is attributed mainly to the increased network benefits caused by the shifts in the adoption status within one's local network. Other things being equal, if the current product gives more network benefits, other the consumer can hardly switch to the other incompatible product because she will lose all her network benefits from the current product. Thus, the switching costs in the network market are the network benefits from the currently using product.

Much of prior work has provided the sources of costs hindering or stimulating the consumer from switching to an alternative technology in the durable goods market [15]. We confined our analysis to the influence of network effects on the network market. Therefore, we ruled out other factors to affect switching decision except network effects. Detailed simulation procedures are provided in Appendix A.

4. Results and Discussion

The main objective of our study is illustrating the impacts of the local network structure on the market outcome and how to take advantage of its characteristics when introducing a new product. First, we showed how the market outcome changes in the different sizes of the local network. The simulation process is provided in Appendix. Following the Arthur's model, two firms compete under the equivalent conditions. First, they select one initial adopter randomly and the following process is the same as the one in Appendix.

4.1 Network Effects under Locality

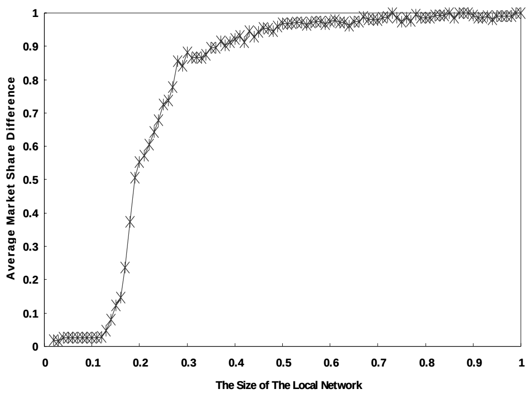
Prior studies argued that the network market tends to become a monopoly by the network effects that increase with the growth of the network. They assumed implicitly the global network, where everyone affects everyone else's purchase decision. Liebowitz and Margolis [16] argued that multiple networks arise under the local network.

Proposition 1 *Under the presence of the local network, the market tends to be shared by two technologies. The market becomes monopolized at the global network.*

We conducted an analysis to show the market share difference of two technologies under the various sizes of the local network. We plot the average market share difference along the y-axis. This was obtained from 100 simulations. The zero value of y implies that the market is evenly divided by two technologies. When y = 1, the market becomes monopolized. The x value represents the degree of locality of the network, which is obtained by denominating the size of the local network by the entire network size. Further, we termed this as *k*.

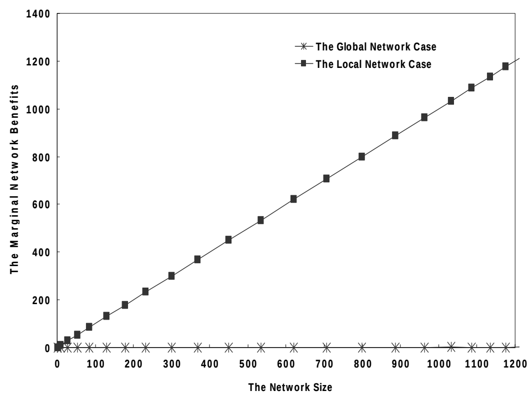
In Figure 2, the network market exhibits a clear distinction in the market outcome depending on the network structure. The market tends to have two technology networks when the size of the local network is relatively small. However, the one network becomes more dominant as the size of the local network approaches that of the global network. At around *k*=0.3, the market share difference levels off and converges to one. Monopoly occurs at the global network at *k*=1.

Figure 2. The Average Market Share Difference with Sizes of the Local Network

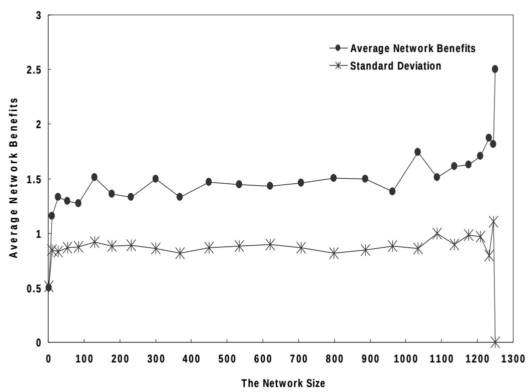


Liebowitz and Margolis [16] noted that marginal network benefits are not increasing in most networks and this opens the possibility of the existence of multiple networks in the network market. Our simulation result is consistent with their argument. Under the global network, the market is subject to the positive feedback mechanism, which is favorable to the firm with a slight advantage in market share [3]. Under the local network, the market growth is restricted by the characteristics of the local network, which limits growth of network benefits. The reason for this different network growth is obvious. Under the global network, for a given size of the network, the marginal network benefit is the same for all prospective customers due to the characteristics of the global network. On the other hand, under the local network, marginal network benefits of each prospective user may be different according to the status of the technology adoption of her local network. To illustrate the difference, we measured the average network benefits. At a relatively small local network size, *k*=0.0576, the network benefit for each prospective user is measured with respect to the growth of the network. We plot the network size along x-axis. Figure 3a shows that the global network experiences a linear increase in its marginal network benefits. Of course, this will result in the exponential network value growth called Metcalfe's law in the telecommunication industry. By contrast, under the local network, average network benefits (or marginal benefits) do not grow beyond one's local neighborhood as we see in Figure 3b.

Figure 3. Network Benefits under the Global and Local Networks



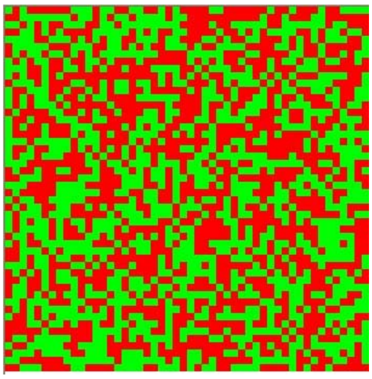
3a) Marginal Network Benefits of Two Networks



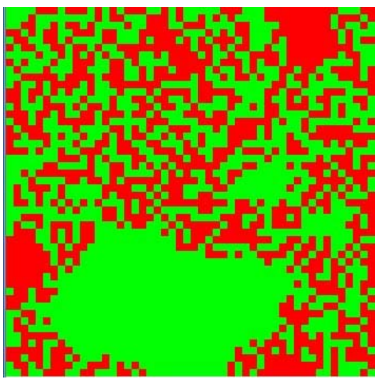
3b) Average Network Benefits of Local Network

The graphical representation of the market outcome under the presence of the network structure sheds more light on the influence of the local network structure. It shows us that the market consists of various customer clusters, each with different size, number, position, and the technology choice, depending on the local network.

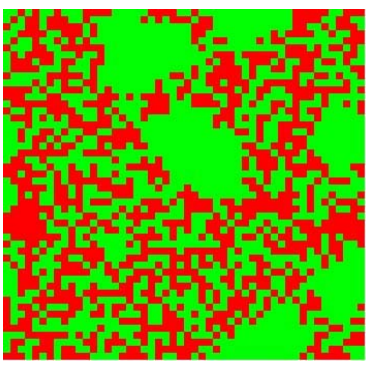
Figure 4. The Patterns of the Adoption Decision at Different Local Network Sizes



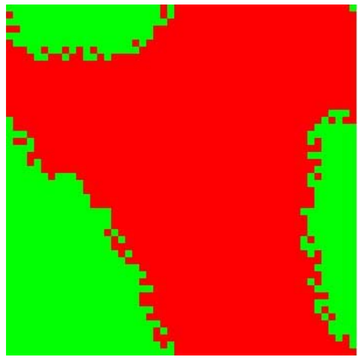
4a) At Size = 10*



4b) At Size = 30



4c) At Size = 30



4d) At Size = 40

The above figures exhibit the adoption status in the market. In Figure 4a, many small islands of a technology are scattered but Figure 4d is composed of big continents of the same technology adopters. That is, as the local network approaches the global network, the size of cluster gets bigger and the number of clusters decreases. Though market shares are almost equal but the topology of the market shares viewed at an individual level can be totally different. We will examine what this implies for marketing below.

4.2 Marketing Strategy under the Local Network

In this section, we investigate whether the locality of network effects makes any difference in a firm's strategy for network growth in new product introduction. In particular, we conduct the analysis of comparing the global network implicitly assumed in much of prior work and the local network. We will show that the marketing strategy in the network market suggested by prior studies should be amended and it can be extended by incorporating the local network. Much of the network literature [2, 9, 23] noted that the build-up of an installed base is crucial to preempt rivals. According to Arthur [2], one technology successfully wins the entire future market by achieving the market share difference beyond a certain threshold. As mentioned earlier, however, prior studies were based on the global network, which prefers only one winner in the market.

The simulation process for the global and local network is equivalent. We adopted the local network model which can represent the various local networks by varying the parameter *k*. The simulation experiment proceeds by the same steps for two networks, which is provided in the Appendix. The only difference in the experiment is the parameter value *k*, which is $m^2 - 1$ for the global network and less than that for other local networks. For various simulation experiments we conducted, we provide the changed parameters and process.

First, we will address the issue of whether the build-up of the customer base is still effective in the local network structure. For this analysis, we assume that one firm can gain an edge by establishing an installed base initially. Firm A starts the market with more initial "seed" adopters than the competing firm with one initial adopter in our experiment. As we expect from the previous finding in Proposition 1, the build-up of initial adopters turns out to be less effective in the local network case. In Figure 5, we plotted the success ratio of the strategy of the build-up of an installed base at a relatively small local network at *k*=0.0576. The success ratio is measured by the number of wins of the sponsored technology A in market share. Therefore, it represents the effectiveness of the strategy. While under the global network market, firm A monopolizes the market with the initial seeds beyond theoretical threshold, we noticed no definite success under the local network market until the level of the installed base was around 400, which amount to the 16% of the entire market.

Figure 5. The Success Ratios of Various Initial Promotion Strategies

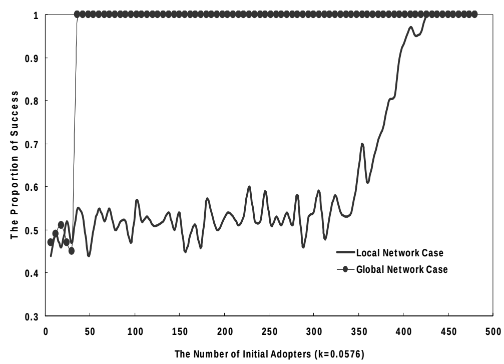


Figure 5 shows that unlike the global market, the firm in a local network needs a much larger number of initial "promoters" in order to be successful [20]. Of course, securing large number of seed adopters may be very costly in the real world. An alternative strategy the firm may consider could be any promotional effort to shift consumers' preference favorably toward its technology. A firm is able to change customers' preference by resorting to launching any type of promotional activities such as advertising. For simplicity of analysis, the amount of change in the preference for the sponsored technology is assumed to be the same for all customers in terms of given investment for a preference shift ε. Mathematically, the change in the effort level is defined as follows:

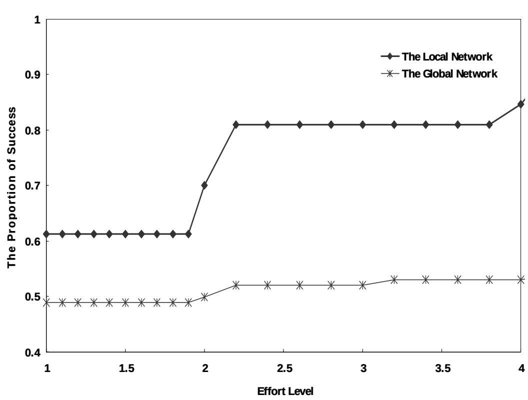
$$U_{RAt}(\varepsilon) = (a_R + \varepsilon) + rn^*_{At} \quad (3)$$

$$U_{SAt}(\varepsilon) = (a_s + \varepsilon) + sn^*_{At} \quad (4)$$

In Figure 6, we provided the success ratios of the strategy in two network cases, the global network and the local network of a relatively small size, *k*=0.2. Under the global network, it appears that there is no substantial increase in the market success along all the effort levels. By contrast, the strategy of enhancing the preference level under the local network is better than under the global network along all levels of change in the preference. Under the global network, the effects of the network size become more dominant when customer utility is based on market growth. Therefore, we expect that the manipulation of preference will have little effect on the market success. However, under the local network, the network effects are limited by the size of the local network so that the network-independent term plays a role in the determination of the customer utilities.

Though we showed that the presence of the local network causes the strategy of expanding the market share to be inferior, we gave no consideration to the strategy of exploiting the local network structure. As Liebowitz and Margolis [16] indicated, people become more concerned with those who really interact at the purchase of the network product. In order to exploit the idea, we suggest that creating a group of initial adopters interconnected with one another will perform better than the strategy of building initial adopters without considering their network.

Figure 6. Market Outcomes with Preference Manipulation



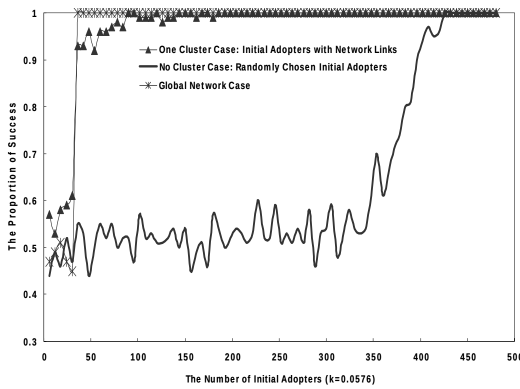
We will show that building a cluster of initial adopters within the local network is more efficient for ensuring that customers are loyal to the product they use. We can imagine the situation of giving out a freebie to customers in the market. If their local network is not considered in this decision, it is highly likely to distribute freebies to people we can easily contact. As a result, it is also likely to happen that those who are offered freebies have no relation with one another. However, most network products have no values by themselves.

They offer benefits to a user particularly when she belongs to the group using the same or compatible product. Therefore, those who were offered freebies may find no compelling reason to remain loyal. Particularly, they become vulnerable to switching to the other product when the number of users for the other product increases within their network and it brings more network benefits to them. On the other hand, those who have less preference toward a technology can stay with it because other members within their network use the same product. Thus, to exploit the idea of the network effects, we create a group or cluster of adopters that turns out to be a stronghold of loyal users.

We conducted the analysis of two cases: The first one is to select customers randomly in the market and make them into initial adopters. Second one is to select one initial adopter and build a cluster of initial adopters consisting of her and her neighbors. We compare the performance of the two cases in terms of success ratios in 100 simulation runs. The x value represents the number of initial adopters. We also plot the performance of the global network and compare it with those two cases.

Figure 7. The Success Ratios of Two different

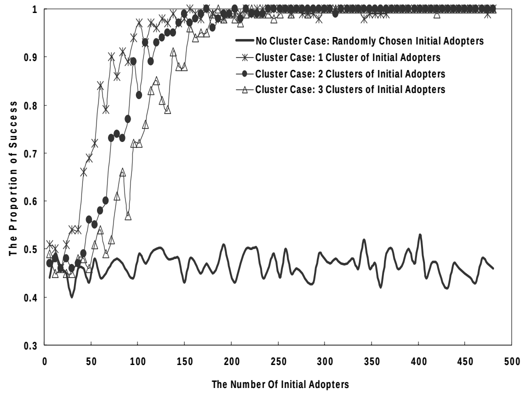
Initial launching Strategies



In Figure 7, we recognized the significant difference in the success ratio between the case with a cluster and the case without a cluster. Thus, taking advantage of the local network by creating a cluster of initial adopters turns out to be more efficient. The strategy of building a cluster performs less well than the global network after the threshold value, which leads to the definite market dominance. The performance of the cluster strategy approaches that of the global network case at around 100, which is much smaller than the number of initial adopters necessary for the strategy of no cluster to win the market.

We also applied this to varying numbers of clusters, where we fixed the total number of initial adopters. We conducted this analysis to see if there are any tradeoffs between the strategies of making one-cluster or multi clusters, which target many smaller niches characterized by sharing the same network.

Figure 8. The Comparison of the Performances of Different Numbers of Clusters (at *k*=0.0576)

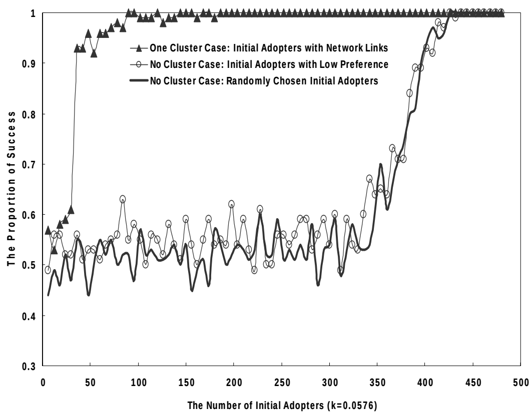


In Figure 8, we recognized that up to around 200 initial adopters, one cluster case works better than the others that have more than one cluster. As the total number of initial adopters increases, the performance becomes equal among all cases. This is ascribed to the fact that each cluster in two or three clusters becomes big enough to work as well as the one cluster case.

According to marketing literature [20], a firm first segments each customer by her characteristics, targets the customer segment, and positions its product within its target market. In the network market, especially under the presence of the local network structure, it is necessary to consider the network structure of the target market segment to promote the product. Though we introduce a new product customized to satisfy the target customer, their neighbors may not be willing to buy it because they find no compelling reason to purchase due to insufficient network benefits. Thus, the adoption no longer proceeds within her network. Thus, to build up initial adopters in the market with network effects, we should pay attention to the existence of the local network and adjust the introduction strategy of the product. Our result presents a critical cautionary note about relying on blind faith in customer segmentation. The following

Figure 9 exhibits this pitfall.

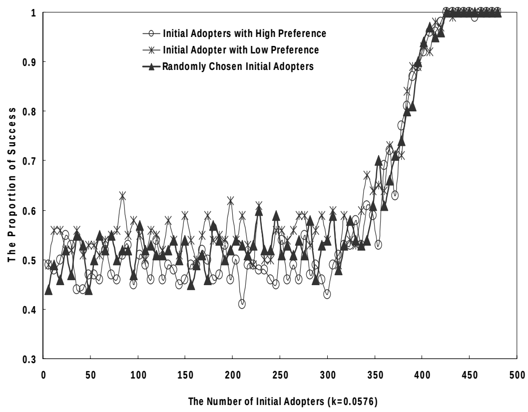
Figure 9. The Performance of the Cluster-building and the CRM strategy



We simplified the firm’s CRM strategy by choosing customers with high preference toward its technology as initial adopters. Figure 9 shows that choosing high-preference customers as initial adopters apparently turns out worse than the cluster-building strategy. It manifests no significant improvement from the performance of choosing initial adopters arbitrarily. Under the existence of the network and its benefits, setting high priority on customer characteristics may cause failure. Besides, we incorporated the other way of choosing those who have low preference as initial customers.

Figure 10 also reveals that no conspicuous enhancement in performance is found in different ways of selecting initial customers based on their preference in comparison with randomly choosing customers.

Figure 10. The Performance of Two Segmentation Strategies



It reinforces our finding that the exploitation of the local network structure by creating a cluster of initial adopters brings about market success.

Proposition 2 *In the presence of the local network, the creation of the segment with interlinked initial adopters is more effective than the segmentation by the customer preference.*

5. Conclusions

The objective of our study is the revisit of the network market competition and its marketing strategy in the light of the local network. Much of prior work on the network market has been conducted primarily in the light of the global network, a special type of the local network. Our study shed some light on the network market phenomena and its marketing strategies in the presence of the local network.

First, we constructed the local network model which can represents a variety of the local network, including the global network as a special type of the local network. Based on this model, we showed that the local network market does not turn out the dominant market player as prior studies suggested. However, it can be monopolized when its structure approaches the fully connected network, the global network. The winner-takes-all market in the network industries is not the general outcome of the competition but a special case in the global network. In the presence of the local network, a variety of the market outcome exists but the monopoly market emerges as the network structure approaches the fully connected network, so called the global network.

Second, prior to the global network, there is the local network market which shows winner-takes-all market phenomena. This extends the study of Liebowitz and Margolis [17]. They argued the existence of the multiple networks in the local network and criticized the naïve assumption made by much of prior work which leads to the eventual emergence of the dominant network in the network industries. Our study shows that although the global network in reality cannot be easily found, the winner-takes-all market phenomena can occur in the local network as the size of the local network increases. Thus, as the number of people within one's network grows and they are the source of the significant network benefits, the market can be tippy and as a result, the build-up of the customer base will be more essential in the network market.

Third, we exhibited that a strong local network market can be inclined to be tippy particularly when the supply-side effects are considered. Thus, prior network studies, based on the global network market scheme, have neglected this and therefore, ascribed the typical network market dominance to the characteristic of network effects in the demand-side market. Our study enriches the network market phenomena by incorporating the local network model which can synthesize the local and global network.

Finally, we reconsidered the conventional network market strategy in the local network market. We extend this finding into CRM strategy particularly at the stage of product introduction. It is shown that the build-up of an installed base under the local network turns out to be a far less efficient way than under the global network. Under the presence of the network structure, the number of initial adopters in one's network matters. As a more network-focused installed-base building strategy, we illustrated that the cluster-building strategy, which builds up a cluster comprised of initial adopters, shows substantial improvements in market success. Thus, it is strongly recommended that there should be great discretion investing in building up the initial adopters, when the market is characterized by the network benefits created at a local network.

The properties of the local network should be considered when choosing the target customers. Our study illuminates that the segmentation strategy based on the customers' characteristics may lead to an inefficient launching strategy. Focusing on targeting customers individually is sometimes not a good way to create loyal customers when it is implemented without taking their relationship network into account. Thus, it should be pointed out that CRM strategy should put more emphasis not only on the customer characteristics but also on the customer relationship particularly in the network industry, where the benefits from the local network affect purchase decision.

The recent focus of marketing practice has been moved from mass and target marketing to one-to-one marketing thanks to the great improvement of digital technology. Marketing practitioners are now able to know an individual customer and take advantage of the state-of-the-art technology to manage customer's information and utilize it for implementing selective and differentiated marketing activity. One-to-one marketing has been prevailing particularly in online business and even becomes the essential part of the entire business area.

Nonetheless, our study can shed some light on the marketing practice, particularly in the presence of the local network effects in network industries. The exploitation of network effects by building up a cluster of customers who can share network benefits is beneficial in the network industry. For instance, many mobile service providers set up the marketing campaign to build up the customer segment in terms of their connectivity. MCI's calling circle program is the marketing campaign that provides a discount on calls within the consumer's friends and family network using MCI's serviced. That campaign allows MCI to expand its market dominated by AT&T. This strengthens the lock-in of adopters by increasing the collective switching costs [23].

6. Limitations and Further Studies

In our study, customers are assumed to be two types with regard to their preference for two incompatible technologies. Implicitly, customers already recognized the characteristics of those technologies completely and formed their own preferences. However, as for newly released products, it may be uncommon that customers are completely aware of and have formed preferences. Therefore, they are sometimes reluctant to try new products or venturesome enough to be the vanguard of the newest technology. Thus, the time for adoption varies in terms of a customer's attitude toward a new technology. In diffusion studies, adopters are categorized by the rate of adoption, the so-called 'innovativeness', which explains how early a potential customer adopts an innovative product [21]. The distribution of adopters with respect to their innovativeness usually follows a normal, bell-shaped curve. Our study can be extended by incorporating the heterogeneous population with a different degree of innovativeness, particularly for the new products of which qualities are unknown to potential customers.

The change of network topology may be an area for improving our study. We focused on the influences of the conventional network strategy given a network topology. Assessing the value of the local network under the various topologies was not the issue of our study. According to recent CRM literature [20], the promotional activity done by loyal customers is becoming more relevant to encourage further growth of sales. Therefore, it is inevitable to evaluate the local network chosen as an initial seed in terms of whether it can facilitate more successful promotion. The topological change of the network may enlarge our insight in this respect.

Appendix

A. Simulation Procedures

1. Create the n x n Lattice with n*n number of cells and assign technology preference to each cell ensuring that the proportions of those who prefers respective technology are equal. Then set a number of neighbors to each cell.
2. Select randomly *m* number of initial adopters of each technology. Then they become the first seeds of triggering the adoption of each technology.
3. Next, the neighbors of initial adopters will decide on which technology to adopt according to their utility function. Their network benefits are determined by the size of the respective network at prior time step. Those neighbors who chose a technology will become new seeds who triggers the adoption of their neighbors at next step
4. At each step, there are two cases for individuals to become the seeds for the next step. First, newly adopting individuals are the ones who should get into the new seeds because their decisions will surely affect their neighbors. Second, those who already adopted but changed their decision should be the seeds for the next step because a change in their decision is also influencing on their neighbors.
5. Finally, the simulation stops when there are no new seeds for the next step.

B. Parameter values for Simulation Runs

Table 2. Utilities of two-type agents in our study

Utilities for each agent	Technology A	Technology B
R-Agent	$a_R + rn_A^*$	$b_R + rn_B^*$
S-Agent	$a_S + sn_A^*$	$b_S + sn_B^*$

* n^* represents the number of the adopters within each agent's local network.

* a_R and b_R represent the basic preference of R-agent toward respective technologies A and B. And a_S and b_S represent the basic preference of S-agent toward technologies A and B.

* *r* and *s* are coefficients of the local network externalities, which represent the positive local network externalities when they are positive.

Table 2. Parameter Values

Parameters	Values
Lattice Size	Row: 50 Col: 50
a_R	35
b_R	5
a_S	5
b_S	35
r	1
s	1
Number of Initial adopters	1

*We set the environment of the simulation runs to reflect that R agent prefers A technology and S agent prefers B. We also allowed the symmetric conditions for the adoption, incorporating the same utility values from the basically preferred choice and less preferred choice for each agent. The coefficients of the local network benefits was set to be the same positive value, which ensures both positive network externalities and equal benefits from each technology when the number of adopters of each technology are the same.

C. The measurement of the Local Network Value

$$NV_t\text{(Network Value at time t)} = \sum_{i \in A_t} \alpha n_{it}$$

where α represent the coefficient of the network effects and n_{it} is the number of adopters within *i* customer's neighbors at time *t*. A_t is a set including all adopters in the market at time *t*.

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