Should We Wait? Network Externalities, Compatibility, and Electronic Billing Adoption

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ABSTRACT: This study examines the adoption of electronic bill presentment and payment (EBPP) technology. EBPP continues to grow and will become a multi-billion dollar e-commerce industry. The technology adoption configuration in this context is quite interesting because it involves four stakeholders: billers, bill consolidators, banks, and consumers. Banks and bill consolidators compete to act as an intermediary between billers and consumers. Network externalities play a significant role: the more billers that adopt the technology, the more consumers are willing to use the services. Our analysis is based on the welfare economics concept of finding the socially optimum adoption configuration and the resulting adoption pattern in a market with sponsored technologies. The results show that due to network externalities, billers are more likely to adopt the existing technology early, though the next technology might be superior to the current one. When the higher costs of early adoption are taken into account, the model shows that billers are more willing to wait, *ceteris paribus*. Our results also show that anticipation of a new and better, but compatible, technology might cause billers to wait, depending on what benefits they expect by adopting early, and how much cost they anticipate to incur upgrading their technology later.

KEY WORDS AND PHRASES: electronic billing presentment and payment (EBPP), electronic commerce, financial services network externalities, standards, technology adoption.

Journal of Management Information Systems / Fall 2001, Vol. 18, No. 2, pp. 47–63.

0742–1222 / 2001 $9.50 + 0.00.

Electronic bill presentment and payment (EBPP) is a technology solution that allows billers to present bills electronically to the consumers and, on the other hand, enables consumers to initiate electronic payments. Thus, EBPP consists of two sectors: (1) electronic bill presentment, which is focused on electronically transmitting bills from businesses to consumers, and (2) electronic bill payment, which is focused on electronically transmitting payments from consumers to businesses [1]. EBPP will particularly appeal to corporations in the financial services, telecommunications, and utilities industries, which typically produce hundreds of thousands to millions of bills each month.

The potential of EBPP is huge. Burnham [1] likens the electronic payment sector in the e-commerce industry to Chevrolet in the automotive industry: The cars are not sexy or terribly exciting, but they are big in their marketplace and will create a dependable source of revenues and profits. Indeed, it is its size that makes EBPP very attractive. By some reports, 60 percent of the 62 billion pieces of first-class mail delivered annually by the U.S. Postal Service are bills [2]. Accordingly, EBPP has the potential for saving $7 billion or more annually, considering that electronic billing typically saves a company about 20 to 30 percent of the costs of the traditional billing methods, which normally run from $1 to $1.50 per invoice—including the costs of printing and sending a bill as well as those of receiving and processing the payment [9].

Many people believe that EBPP will eventually enjoy wide adoption among billers as well as consumers. "E-billing and payment are going to be as ubiquitously available as e-mail now on the Net," predicts Peter Kight, head of CheckFree. But for the moment, it appears there is a "chicken-and-egg" problem that afflicts the industry: consumers do not want to sign up unless lots of companies send bills online, and businesses do not want to send bills online unless lots of consumers sign up [14, 15].

The issue for billers is not whether to present bills over the Internet, but when to do it. EBPP solution models are still evolving. There are currently two major groups that eventually will compete against each other to lure both billers and consumers into using each service. The first group consists of banks. Some of them already have spent a lot of money developing online billing services. A major player in this group is a consortium of banks called Spectrum, which has set out to devise a standard but has not really finished the work [15]. Spectrum is testing its method of sending bills electronically, but has not devised a way to let consumers pay bills online [22]. The second group consists of bill consolidators, which are a third party that aggregates data from multiple billers and prepare bills for presentment through arrangements with banks or popular Internet portals such as Yahoo and America Online. Bill consolidators (e.g., CheckFree and TransPoint) seem to be more ready with their service offerings of EBPP than banks do. As a matter of fact, some banks have actually partnered with bill consolidators to deliver EBPP services to their customers.

A survey by Gartner Group [16] reports that nearly half of all major billers present consumer bills over the Internet in 2000, and almost 80 percent of banks with deposits greater than $4 billion offer consumer online bill payment. However, the real barrier to EBPP adoption is in the electronic bill presentment sector. The Gartner Group report suggests that consumers are only likely to sign up for EBPP if they are able to get most—if not all—of their bills online, which means that the bills must be aggregated/consolidated and presented at one site. However, this aggregation has not been accomplished mainly because of competitive positioning.

The current situation leaves us with an interesting question: Why have some of the billers decided to adopt the EBPP technology despite the uncertainties? In this paper, we analyze a model of EBPP adoption based on the welfare economics concept. We examine how higher costs of early adoption might affect a biller's decision to adopt. We also investigate the impact of network externalities on the decision to adopt. The analytical model suggests that higher costs of early adoption will make it more likely for a biller to wait, but a sufficiently high expectation of network benefits will compensate for the higher costs of early adoption and cause a biller to adopt early. Further, a biller may wait for a new and better, but compatible technology, depending on what benefits the biller would expect by adopting the existing technology and how much cost it anticipates to upgrade its technology later.

The concepts of network externalities and their effects on technology adoption have been discussed by a number of authors (e.g., Choi and Thum [4]; Economides [7]; Hoppe [10]; Farrell and Saloner [8]; Katz and Shapiro [11, 12]). In this paper, we extend the model by Choi and Thum [4] by introducing a stand-alone benefit-discounting factor to take into account the higher costs of early adoption, and by taking out the assumption that the next technology is superior to the current one. We also look into the situation where compatibility and standards are taken into account. We offer both theoretical and managerial perspectives as we discuss our model in the context of the EBPP industry.

Literature

KATZ AND SHAPIRO [11] DEVELOP A PARTIAL equilibrium oligopoly model in which consumers value a product more highly when it is compatible with other consumers' products. They call this effect *network externalities*. EBPP exhibits network externalities since the more billers that offer the service, the more consumers are willing to sign up. Thus, the value of each biller's EBPP system will increase with the number of billers offering the same service. Network externalities play a significant role in influencing the decisions of firms and consumers to adopt early. Economides [7] suggests that in network markets, when firms and consumers interact in more than one period, they make production and consumption decisions based on the size of installed base and on expectations of its increases over time. Depending on the way things start, the same underlying technology and consumer preferences and distribution can lead to different industrial structures. Strategic advantages, such as first-mover advantages, can have long run effects.

Hoppe [10] argues, however, that being first can involve high costs and uncertainty. The introduction of uncertainty about the benefits of a technology brings about the possibility of second-mover advantages in equilibrium. Once a firm adopts the new technology and thereby reveals the technology's true benefit, the rival firm will have a chance to revise its adoption decision based on the knowledge as to whether adoption will be profitable. This will then become the basis for a second-mover advantage due to the irreversibility of investment. In similar vein, Farrell and Saloner [8] suggest—in the context of standardization and compatibility—that even though in some cases there might be benefits to early adoption, it may turn out to be costly if it takes too long for the majority of the firms in the industry to follow. Furthermore, there is a possibility that they may not follow.

Katz and Shapiro [12] analyze technology adoption in industries where network externalities are significant. The pattern of adoption depends on the configuration of the sponsorship of competing technologies. In this case, a sponsor refers to an entity that has the property rights to the technology and is willing to make investments to promote it. They find that when one of two competing technologies is sponsored, that technology may be adopted even if it is inferior. However, when both competing technologies are sponsored, the technology that will be superior tomorrow has a strategic advantage. On the other hand, when neither technology is sponsored, the technology that is superior today is likely to dominate the market.

Choi and Thum [4] extend the work of Katz and Shapiro [12] by considering the option of waiting. They analyze a simple two-period model with two incompatible technologies, and two groups of consumers of the same size arriving sequentially at the two different periods. They find that even in a completely competitive environment—where both technologies are offered at marginal cost prices—consumers are too impatient with respect to the waiting option and adopt an existing technology too early. The early consumers ignore the network benefit they could generate for themselves and the subsequent consumers, and adopt the inferior technology in too many cases. The problem is worsened when the new technology is sponsored: the early consumers will less likely wait since they anticipate that any consumer surplus generated by waiting will be appropriated by the monopolistic supplier of the new technology. This finding is in sharp contrast to Katz and Shapiro's [12] result—where there is a bias toward the sponsored technology—due to major differences in their assumptions.

In the information systems (IS) area, a number of theoretical models that involve network externalities have been developed by several authors (e.g., Chismar and Meier [3]; Clemons and Klendorfer [5]; Conner [6]; Nault and Dexter [20]; Riggins et al. [21]; Wang and Seidmann [25]). These models build on the theoretical networks literature in economics, and are used to analyze IS products or services that exhibit network characteristics. The general finding is that network externalities play an important role in the adoption and valuation of network goods.

In recent empirical work, Kauffman et al. [13] present the results of a study of the adoption of electronic banking in the financial services industry. Using the hazard modeling econometric technique, they find that banks in markets that can generate a larger effective network size and a higher level of externalities tend to adopt early, supporting the network externalities hypothesis.

In the game-theoretic context employed in the two-period model in this paper, network externalities play a significant role in each biller's adoption decision since the expected network benefits contribute toward the level of welfare each player might expect. For instance, in the process of considering whether to adopt the EBPP technology in the first period, a biller will try to predict the type of action the other biller will take in the next period. Depending on whether the other biller will choose the same technology or a different technology in the second period, the biller in the first period will or will not include network benefits in its welfare calculation.

The Adoption Framework

Figure 1 depicts the adoption framework of EBPP. The arrows indicate the possible adoption scenarios.

Billers can adopt the solution offered by either the bill consolidators or the banks. Banks, even though some of them choose to develop their own standards, have the option to adopt the technology owned by the bill consolidators. Consumers, on the other side of the equation, can choose to receive and pay their bills online, either through a bank or a bill consolidator. The ellipse indicates the scope that this study will focus on, that is, the adoption scheme among billers, banks, and bill consolidators.

EBPP Stakeholders

As indicated in the framework, there are four stakeholders in the electronic bill payment and presentment industry: billers, banks, bill consolidators, and consumers. Since the model in this paper will be analyzed using the welfare economics concept, it is important to list the benefits that each stakeholder could potentially obtain from the use of EBPP.

- *Billers.* As consumers adopt EBPP systems, billers will save money from the reduced costs of generating bills. In addition, billers can also use the EBPP systems to enhance relationships with consumers. For example, billers can offer new services based on dynamic and real-time information exchange as well as personalized marketing campaigns that target specific groups of consumers.
- *Banks.* Banks will obtain benefits from the fees that billers and consumers pay. An EBPP system is likely to generate stickiness to a bank's Web site, which means that consumers will return to the bank's Web site out of habit. With billions of bills generated and mailed every year, millions of repeat site visits could be expected. This will create the opportunity for the bank to cross-sell its services and products. Furthermore, banks will enjoy lower attrition rates of the existing customers.
- *Bill consolidators.* Bill consolidators will benefit from the fees from both billers and consumers. In addition, the consolidators' portals will enjoy an increased number of visits from consumers.
- *Consumers.* Consumers will enjoy the convenience of one-stop bill payment, saving them time and, possibly, some money (on postage stamps).

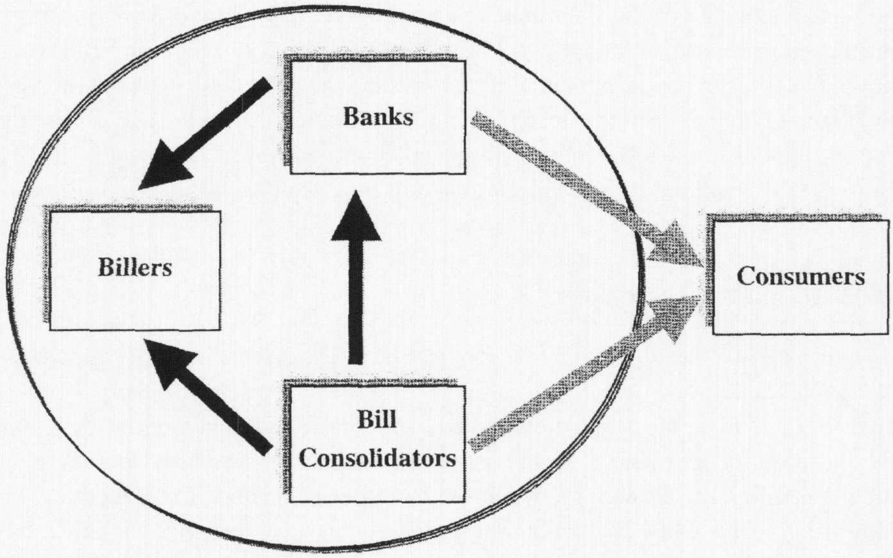

Figure 1. EBPP Adoption Framework

Table 1 lists the major players and the current status in each of the stakeholder categories.

An Optimal Adoption Decision-making Model

The basic setup in this paper is a variant of the work by Choi and Thum [4]. In their setup, they consider a simple two-period model with two incompatible technologies, A and B, with two groups of users of the same size, 1 and 2, arriving sequentially at times t = 1 and 2, respectively. User 1, who arrives at the market in Period 1, can either buy Technology A—the only technology currently available—or wait until Period 2, when Technology B enters the market. In Period 2, a new group of users (i.e., User 2) arrives in the market and makes a decision between Technologies A and B, given the choice of User 1. Technology B is assumed to be superior to Technology A. Therefore, if User 1 opts to wait until Period 2, both users will choose to adopt Technology B. However, if User 1 decides to adopt Technology A in Period 1, there is a possibility that User 2, who arrives in Period 2, will also adopt Technology A—even though it is inferior to Technology B—due to network externalities.

The model in this paper eliminates the assumption that Technology B is superior to Technology A.[1] However, we assume that if User 1 has adopted Technology A in Period 1, then it will not be economically feasible for the user to switch to Technology B in Period 2. In our EBPP framework, Technology A is the technology currently offered by the bill consolidators (e.g., CheckFree and TransPoint) and is assumed to be available earlier (i.e., in Period 1), whereas Technology B is the technology that will be offered by the banks (e.g., the Spectrum consortium led by Chase Manhattan,

Table 1. Major Players and Current Status in Each Stakeholder Category

Stakeholder	Major Players and Current Status
Billers	• High-volume billers—that is, billers with more than 250,000 recurring bills—are mostly companies in the credit cards, cable, telephone, utilities, insurance, and lending industries. They account for approximately 80% of all of the recurring bills sent out annually to consumers and business customers in the United States. Nearly half of the high-volume billers presented consumer bills over the Internet in 2000 [16].
Banks	• The Spectrum Consortium (Chase Manhattan, First Union, Wells Fargo): The three banks in aggregate manage 60 million consumer and small business accounts, 59,000 U.S. corporate accounts and produce over 300 million recurring bills a year [15]. • Bank of America (BofA): With 30 million households and 2 million business accounts, BofA is comparable in size to the three Spectrum bank owners. However, only about 1% of BofA's 30 million customers use the bank's own online bill payment service [17].
Bill Consolidators	• CheckFree and TransPoint: CheckFree spent nearly $1 billion buying chief rival TransPoint in 2000 [18]. As of July 2000, CheckFree had a base of 3.5 million bill-paying consumers [19].
Consumers	• Only about 4 million U.S. households used EBPP as of the end of 1999, compared to more than 50 million households that had Internet connections [16]. Almost half (49.5%) of about 130 million U.S. adult Internet users do not want to receive bills online, according to Gartner Group's research on 40,000 households from March 2000 [19].

First Union, and Wells Fargo) in Period 2. The group of billers that is currently considering adopting the EBPP technology is represented by Biller 1. This group will either adopt Technology A or wait until Technology B is available in Period 2.

Billers that are not currently considering EBPP adoption—but will do so in Period 2—are referred to as Biller 2. In Period 2, Biller 2 will adopt either Technology A or Technology B. Therefore, there are four possible patterns of adoption: (1) both billers adopt Technology A (AA); (2) Biller 1 adopts Technology A and Biller 2 selects Technology B (AB); (3) Biller 1 waits until Period 2 and both billers adopt Technology A (OA); and (4) or Biller 1 waits until Period 2 and both billers adopt Technology B (OB).

Choi and Thum [4] ignore alternative OA since it is strictly dominated by OB, due to the assumption that technology B is superior to technology A. However, in the case of EBPP, it is uncertain that the technology that is going to be offered by the banks (Technology B) will be superior to the one offered by the bill consolidators (Technology A). There is even a possibility that the banks will eventually decide to adopt the technology that the bill consolidators own, making alternative OA completely viable.

We will denote a and b as the stand-alone benefit that a biller will obtain from using Technology A and B, respectively. We assume that the costs of adopting earlier in

Table 2. Description of the Modeling Notation

Notation	Description
A	Technology A, offered by the bill consolidators in Period 1 (and Period 2).
B	Technology B, offered by the banks in Period 2.
a	Stand-alone benefit of Technology A.
b	Stand-alone benefit of Technology B.
n	Network benefit.
O	No adoption decision made in Period 1. Biller 1 opts to wait until Period 2
ϕ	Benefit-discounting factor ($0 < \phi < 1$)
δ	Stand-alone benefit-differential of Technology A and B (i.e., $b - a$).
W	Welfare, that is, the sum of individual benefits.

Period 1 are larger than those of adopting later in Period 2. By taking the cost into account, the stand-alone benefit of Technology A, when it is adopted in Period 1, will be smaller than in Period 2. We will denote $\phi\, a$ as the stand-alone benefit of adopting Technology A in Period 1, where ϕ is a benefit-discounting factor that has a value between 0 and 1 ($0 < \phi < 1$). The greater the adoption cost differential is, the smaller the value of ϕ will be. We will also denote n as the network benefit that each group will get from adopting the same technology. Table 2 summarizes the notation that we use in this paper.

Assuming that Biller 1 and Biller 2 are of the same size, for each adoption alternative, we can write the welfare, W, defined as the sum of individual benefits, as follows:

- The welfare level when Biller 1 adopts Technology A in Period 1 and Biller 2 follows suit in Period 2 is:

$$W_{AA} = \phi\, a + 2\,(a + n) = (\phi + 2)\, a + 2n.$$

- The welfare level when Biller 1 adopts Technology A in Period 1 and Biller 2 adopts Technology B in Period 2 is:

$$W_{AB} = \phi\, a + (a + b) = (\phi + 1)\, a + b.$$

- The welfare level when Biller 1 chooses to wait until Period 2 and—together with Biller 2—adopts Technology A in Period 2 is:

$$W_{OA} = 0 + 2\,(a + n) = 2a + 2n.$$

- The welfare level when Biller 1 chooses to wait until Period 2 and—together with Biller 2—adopts Technology B in Period 2 is:

$$W_{OB} = 0 + 2\,(b + n) = 2b + 2n.$$

The welfare for pattern AA—that is, when both billers adopt Technology A—is the sum of the stand-alone benefit that Biller 1 gets in Period 1 and the stand-alone plus the network benefit that both obtain in Period 2. In case of pattern AB, the welfare is the sum of the stand-alone benefits of Biller 1 from Technology A in Period 1 and Period 2, and the stand-alone benefit of Biller 2 from Technology B in Period 2. There is no network benefit in this case since each group adopts a different technology. The welfare formula for patterns OA and OB can be interpreted similarly. Notice that W_{AA} is always greater than W_{OA}, which means that if it is known that Technology A will be superior to technology B, then Biller 1 will be better off if it adopts Technology A in Period 1 and does not wait until Period 2 to decide.

By comparing the different welfare levels, we can derive the socially optimum adoption pattern. With four different welfare levels and $\delta = b - a$, we can write the six unique pair-wise comparisons as shown in the expressions below:

$$W_{OA} > W_{OB} \Rightarrow 2a + 2n > 2b + 2n \Rightarrow \delta < 0,$$

$$W_{AA} > W_{OA} \Rightarrow (\phi + 2)a + 2n > 2a + 2n \Rightarrow \phi > 0,$$

$$W_{AA} > W_{OB} \Rightarrow (\phi + 2)a + 2n > 2b + 2n \Rightarrow \delta < \phi a/2,$$

$$W_{AA} > W_{AB} \Rightarrow (\phi + 2)a + 2n > (\phi + 1)a + b \Rightarrow \delta < 2n,$$

$$W_{AB} > W_{OA} \Rightarrow (\phi + 1)a + b > 2a + 2n \Rightarrow \delta > 2n - \phi a,$$

$$W_{AB} > W_{OB} \Rightarrow (\phi + 1)a + b > 2b + 2n \Rightarrow \delta < \phi a - 2n.$$

Table 3 contains a description of each of the pair-wise comparisons.

Modeling Results

We next report on results for this model involving unsponsored and sponsored technologies. The contrast between the two is interesting, both in the specific context of EBPP and the more general context of technology adoption.

Adoption of an Unsponsored Technology Solution

Figure 2 depicts the socially optimum adoption configuration based on the results of the six pair-wise comparisons of the welfare levels when the technology solution is unsponsored, and the developer of the technology retains no residual right to resell it. With this condition in mind, the developer does not have the right to set the price of the technology in the marketplace in response to pricing threats and developments from other competitors. The horizontal axis represents the stand-alone benefit differential of Technology A and B (δ), whereas the vertical axis measures the network benefit of adopting the same technology (n).

If $\delta < 0$—a situation in which technology A is superior to Technology B—then there are two possible adoption patterns. The first pattern is when Biller 1 decides to adopt Technology A in Period 1, and Biller 2 also chooses to adopt Technology A in

Table 3. An Overview of the Patterns of Adoption

Comparison	Description
1. $W_{OA} > W_{OB}$	Both billers choose to wait and adopt Technology A rather than Technology B in Period 2.
2. $W_{AA} > W_{OA}$	Biller 1 adopts Technology A in Period 1 rather than wait until Period 2, and Biller 2 follow suit in Period 2.
3. $W_{AA} > W_{OB}$	Biller 1 adopts Technology A in Period 1 rather than wait until Period 2, and biller 2 also adopts Technology A rather than Technology B in Period 2.
4. $W_{AA} > W_{AB}$	Biller 1 adopts Technology A in Period 1, and Biller 2 also adopts Technology A rather than Technology B in Period 2.
5. $W_{AB} > W_{OA}$	Biller 1 adopts Technology A in Period 1 rather than wait until Period 2, and Biller 2 adopts Technology B rather than Technology A in Period 2.
6. $W_{AB} > W_{OB}$	Biller 1 adopts Technology A in Period 1 rather than wait until Period 2, and Biller 2 adopts Technology B in Period 2.

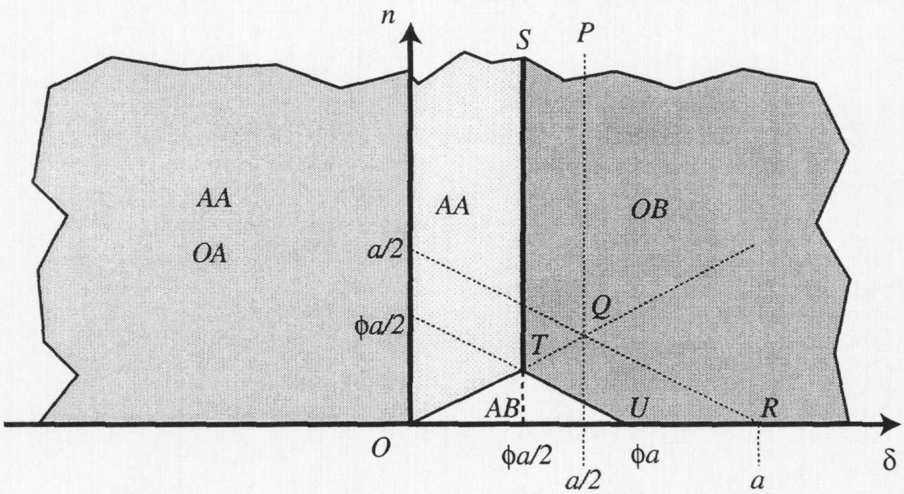

Figure 2. Socially Optimum Adoption Configuration. *Note:* The stand-alone benefit discounting factor (ϕ) will increase the willingness of Biller 1 to wait. In addition, the smaller that ϕ is, the more Biller 1 is willing to wait, and the less the influence of expected network externalities will be in making Biller 1 adopt early.

Period 2 (pattern AA). The second pattern is when Biller 1 decides to wait until Period 2 and adopts Technology A together with Biller 2 (pattern OA).

If $\delta > 0$, which indicates that Technology B is superior to Technology A, then there are three patterns of adoption. The first is when Biller 1 adopts Technology A in Period 1, and Biller 2 also adopts Technology A in Period 2. This is depicted by area AA to the right of the vertical axis in Figure 2. This pattern will apply if $\delta < 2n$ and

$\delta < \phi\, a/2$, which indicate that the benefit differential of Technology B and Technology A is relatively small compared to the network benefit and to the discounted stand-alone benefit of Technology A. The second pattern is when Biller 1 adopts Technology A in Period 1, whereas Biller 2 adopts Technology B in Period 2. This is depicted by area AB in Figure 2. This will be the case when $2n < \delta < (\phi a - 2n)$, which means that the discounted stand-alone benefit of Technology A in Period 1 is relatively large compared to the network benefit. Therefore, because of the relatively small network benefit, there is no justifiable reason for standardizing the technology. The third pattern applies to the situation where Biller 1 chooses to wait until Period 2 and—together with Biller 2—adopts Technology B. This circumstance is depicted by area OB in Figure 2. In this case, the stand-alone benefit-differential of Technology A and Technology B is large enough to make Biller 1 wait for Technology B.

Furthermore, by considering the cost-differential of adopting Technology A in Period 1 and 2—that is, by taking into account the benefit-discounting factor ϕ—the resulting area of OB becomes larger. This is shown in Figure 2 by the area to the right of PQR when no cost-differential is assumed, and that to the right of STU when there is a factor of ϕ. As ϕ gets smaller, the area of OB gets larger. This suggests that Biller 1 is more likely to wait until Period 2 if the cost of adopting Technology A in Period 1 becomes much higher compared with Period 2.

Adoption of a Sponsored Technology Solution

The EBPP market structure has the characteristics of a market in which the developers of the technologies retain the exclusive rights to sell the technologies. This allows the developers to set and adjust prices strategically based on the competition in the market.

To analyze this sponsored technologies situation, we will first denote p_A and p_B as the price of technology A and B, respectively. To enable us to understand its characteristics in this particular market structure, we exclude the price from the cost of technology adoption and treat it as a separate entity in our welfare formula. In our model, if $\delta > 0$ and Biller 1 has chosen Technology A in Period 1, then in Period 2 Biller 2 will also choose Technology A (i.e., pattern AA) if and only if the welfare of adopting the same Technology A is greater than that of adopting Technology B. Using our modeling notation, we can write the condition as:

$$a + n - p_A > b - p_B \Rightarrow p_A < p_B + (n - \delta).$$

If $n > \delta$, Technology B will be forced out of the competition since the producer of Technology A can always set its price lower than that of Technology B, thus, pattern AA will hold. By the same token, Biller 2 will choose Technology B in Period 2—given that Biller 1 has chosen Technology A in Period 1 (i.e., pattern AB)—if and only if $n < \delta$. This condition is represented by the diagonal line OSP in Figure 3, where the area above the line represents the AA pattern and the area below represents the AB pattern.

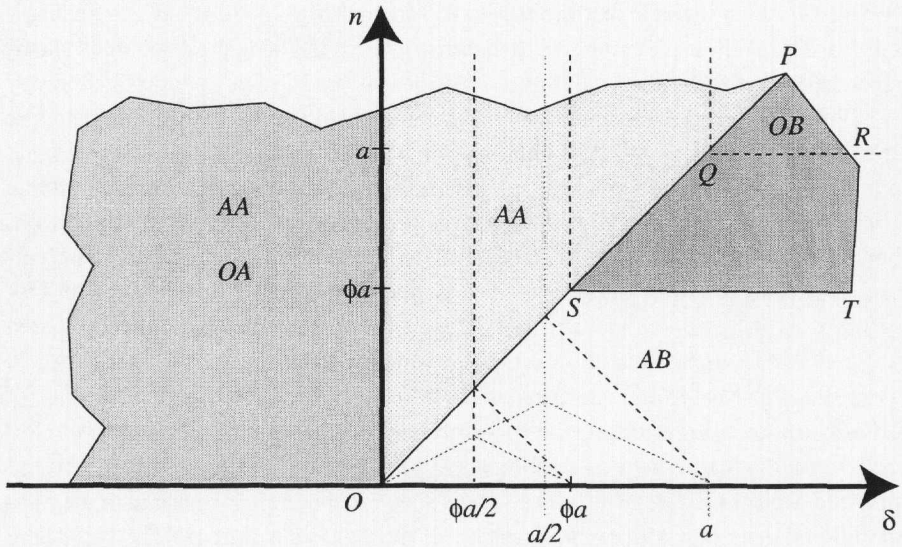

Figure 3. Adoption Configuration of Sponsored Technologies. *Note:* Biller 1 will tend to adopt early even when the expected network benefits are relatively low. The benefit-discounting factor (φ) may increase the willingness of Biller 1 to wait.

We will now consider the situation in which $\delta > 0$ and Biller 2 will choose Technology B in Period 2, regardless of Biller 1's adoption decision. In this case, Biller 1 can either adopt Technology A in Period 1, or wait until Period 2 and adopt Technology B. Note that it is unlikely for Biller 1 to adopt Technology A in Period 2 since, in this particular situation, Technology A will have no advantage at all compared to Technology B. Biller 1 will make its decision based on the relative welfare of the two alternatives. For Biller 1 to wait until Period 2 and adopt Technology B (i.e., pattern OB), the following condition must be satisfied:

$$b + n - p_B > (\phi + 1)\, a - p_A.$$

This means that—for Biller 1—the welfare of adopting Technology B in Period 2 must be greater than that of adopting Technology A in Period 1. Anticipating the possibility of being forced out of the competition in Period 2 if Biller 1 does not adopt Technology A in Period 1, the developer of Technology A will decide to price its technology at zero in Period 1. On the other hand, knowing that Biller 2 will adopt its technology in Period 2, the developer of Technology B will price its technology at the maximum possible level, that is, just marginally below the benefit-differential of the two technologies (δ). Therefore, we have $p_A = 0$ and $p_B = \delta$, and we can rewrite the above condition as follows:

$$b + n - p_B > (\phi + 1)\, a - p_A \Rightarrow b - a + n - \delta > \phi\, a \Rightarrow n > \phi\, a.$$

Another situation that needs to be considered is when Technology A turns out to be superior to Technology B ($\delta < 0$). In this case, if Biller 1 chooses to wait, then both billers will simply adopt Technology A in Period 2 (i.e., pattern OA). However, if Biller 1 has chosen Technology A in Period 1, then Biller 2 will simply follow suit since there is no better alternative (i.e., pattern AA).

Figure 3 depicts the situations just described. As shown in the figure, AA is the more dominant pattern. As in the optimum adoption configuration, the benefit-discounting factor (ϕ) has an effect of causing Biller 1 to wait until Period 2 and adopt Technology B—if $\delta > 0$. This is shown by comparing the area of PQR (without considering ϕ) with the area of PST (by taking into account ϕ).

Adding Standards and Compatibility to the Mix

An important issue to consider is the availability of standards. Shapiro and Varian [24] suggest that standards enhance compatibility, or interoperability, creating greater value for the user by making the network larger. Hence, if Technology A is compatible with Technology B, both Biller 1 and Biller 2 will obtain a network benefit regardless of the technology they choose. Our discussions so far have assumed that Technology A and Technology B are incompatible, which means that it will not be economically feasible to switch from Technology A to Technology B. However, as the following discussion will suggest, there is great likelihood that the developer of Technology B will make its technology compatible with Technology A.

Let us analyze the situation where standards and compatibility exist. If $\delta < 0$, which means that Technology A is superior to Technology B, then Technology A will prevail and either pattern AA or OA will hold. Standards or compatibility will not help Technology B in this case. On the other hand, if $\delta > 0$, then Biller 2 will choose and adopt Technology B in Period 2. Biller 1 has two options: (1) adopt Technology A in Period 1, or (2) wait until Period 2 and adopt Technology B. Biller 1 will choose the latter option if the following condition is satisfied:

$$b + n' - p_B > (\phi' + 1)\, a + n' - p_A$$

$$\Rightarrow b - a - \delta > \phi' a \Rightarrow \phi' a < 0$$

(since we have $p_A = 0$ and $p_B = \delta$ based on the same argument as discussed in the fifth paragraph of the previous section).

Here n' denotes the network benefit that will be enjoyed by both Biller 1 and 2 due to the compatibility of Technology A and B—regardless of whether Biller 1 and Biller 2 choose the same technology—and ϕ' denotes a benefit-discounting factor that includes compatibility cost. We argue that if Technology B is superior to Technology A, then Biller 1—if it decides to adopt Technology A in Period 1—will eventually incur some extra cost (i.e., the compatibility cost) to make its adopted technology on a par with Technology B. This can be done either by switching to Technology B, or by upgrading to an enhanced version of Technology A (if such an option is available). The compatibility cost may either be greater or smaller than the stand-alone benefit (a) that Biller 1 obtains. Therefore, ϕ' can be any negative value or a positive value from 0 to 1.

The condition $\phi' a < 0$ that we have obtained indicates that Biller 1 will wait until Period 2 and adopt Technology B if the biller anticipates that the early adoption and compatibility costs will exceed the stand-alone benefit of adopting Technology A.

Conclusion

THIS PAPER EXTENDS THE MODEL BY Choi and Thum [4] by introducing the benefit-discounting factor and by eliminating the assumption that the next technology is superior to the current technology. In the socially optimum adoption configuration, the stand-alone benefit-discounting factor plays a significant role in causing the billers to wait for the next technology before they make their adoption decision. The smaller the benefit-discounting factor is—that is, the higher the cost of adopting the current technology now is compared to that of adopting it later—the more the billers are willing to wait. Furthermore, the smaller the benefit-discounting factor is, the less the influence of expected network externalities will be in making the billers adopt early.

The adoption configuration of sponsored technologies suggests, however, that being first in the market does advantage the currently available EBPP technology. With sufficient expectation of benefits from network externalities, billers will choose to adopt the existing technology now, despite the fact that the next technology might be superior to the current one. The smaller the stand-alone benefit-differential of the two technologies is, the more likely it is for the billers that are considering adopting to actually implement the current technology now. Even when the stand-alone benefit-differential of the technologies is relatively big, the current technology will still be in a favorable position if the expected benefits from network externalities are high, which seems to be the case in the EBPP market.

The benefit-discounting factor still has an impact on the willingness of the billers to wait in the sponsored technology market structure. The smaller the stand-alone benefit-discounting factor is, the more the billers are willing to wait. However, this again is subject to the benefits from network externalities that the billers expect. Any additional benefits expected from the network externalities will contribute toward compensating for the higher cost of early adoption. Therefore, a high adoption cost will not deter billers from adopting the EBPP technology early, as long as they believe the same technology will be adopted by more billers in the future.

In the case that the next technology turns out to be inferior to the current technology, every biller will simply adopt the current technology. However, there are uncertainties in this case since nobody knows what the outcome will be until the next technology is ready. Therefore, the options for billers remain either to adopt now or later, depending on their benefit expectations.

The results of the analysis in this paper are undoubtedly very encouraging for the bill consolidators, since they are the ones that currently has the readily available technology. As a matter of fact, the latest developments in the EBPP industry clearly show that the bill consolidators are leading the competition. A survey conducted in late 1999 by Gartner Group of 173 large U.S. companies across major industrial sectors—including credit cards, cable, telephone, utilities, insurance, and lending—indicates that while these corporations expect their banks to take the lead in Internet billing, they are turning instead to the bill consolidators, such as CheckFree and TransPoint, for solutions [17]. Businesses expect their banks to take a greater role in EBPP since banks are trusted entities that have long-standing relationships with the companies [17]. However, banking enterprises are at least a year behind the dominant EBPP vendor, CheckFree, which is used by more than 75 percent of the surveyed companies.

Bank of America's newly signed contract with CheckFree, which ended the prior competition between the two in providing EBPP services, further suggests the bill consolidator's current leadership in the industry [23]. Under the 10-year contract, CheckFree will provide EBPP services to Bank of America's customers nationwide. In return, Bank of America will receive a 16 percent stake in CheckFree. Bank of America's latest strategy is in sharp contrast with Spectrum's, whose member banks (Chase Manhattan, First Union, and Wells Fargo) believe that owning the EBPP technology is the best way to control pricing and grow noninterest revenue. In spite of the current developments we should never forget that there are other aspects in the competition, such as the relationships with billers and consumers, that also contribute to the competing power of each player and that will eventually shape the final outcome of the competition.

In this paper, we also analyze the possibility that the next technology will be made compatible with the current technology. In practice, this is likely to happen, as we have seen in the previous section. The anticipation of a new and better, but compatible technology might actually cause billers to wait, depending on what benefits they would expect by adopting early and how much cost they anticipate to upgrade their technology later. Spectrum's recent decision to soon replace its Open Financial Exchange (OFX)-based switch with a superior Interactive Financial Exchange (IFX)-based model, but to continue to support OFX [22], is a good example of a later entrant that tries to win the competition by offering a compatible but better technology.

EBPP is a growing industry and promises huge benefits for all the stakeholders—especially the billers, banks, and bill consolidators—who are able to strategically take advantage of the technology in a timely manner. The timing of adoption is critical, yet there are a lot of uncertainties as the technology is developing and the stakeholders are positioning and repositioning themselves in the competitive arena. Plenty of things seem to be going on at once, causing a blur for the many. In this paper, we extend a model initially developed by Choi and Thum [4] by relaxing some of the assumptions in the original model and including a benefit-discounting factor, which we believe to be representative of the nascent EBPP industry. Our main goal is to apply the welfare economics concept used in the model to bring the adoption issues in the EBPP market to light. Consequently, we are able to offer a combination of theoretical and managerial perspectives. Indeed, the main contribution of this paper lies in the fact that we are able to tie the extended version of the model to the actual phenomenon we observe in the EBPP industry. The approach we use in our model is one of partial equilibrium analysis, where some of the strategies by technology developers are taken endogenously.

We believe the approach provides useful insights into technology adoption in the EBPP industry, even though we have not presented a general equilibrium model of adoption.

Future research extensions of our model can include the relaxation of the assumption that Biller 1 and Biller 2 are of the same size. Indeed, introducing heterogeneity between the two billers would presumably lead to a different result, as the network effect will now differ for each biller. This kind of situation will be seen when larger billers—such as telecoms and utilities—decide to adopt the current technology, and smaller billers wait until the next period, or vice versa.

Acknowledgments: An earlier version of this research was published in the *Proceedings of the 34th Hawaii Conference on Systems Science* (HICSS-34), IEEE Computer Society Press, Los Alamitos, California, 2001. The authors wish to thank the reviewers and participants of HICSS-34, especially Eric Clemons, Rajiv Dewan, Jeff Sampler, and Yu-Ming Wang, for offering useful suggestions that shaped this work. We also thank the anonymous *JMIS* reviewers, who offered additional suggestions that enabled us to refine our claims about the contributions of this research. Finally, we are indebted to Michael Killen, Founder and Chairman of Killen & Associates of Palo Alto, California, for sponsoring our ongoing research on electronic bill presentment and payment in financial e-commerce. All errors of fact or interpretation are the responsibility of the authors.

Note

1. The relaxation of this particular assumption here is to allow for a more complete analysis of the real-world situation that occurs in the EBPP industry, since there is not any strong indication that the banks' technology will be superior to that of the bill consolidators. Of course, if it turns out that the next technology is worse than the current one, then the current technology will prevail (assuming there is not any other factor, such as trust or licensing, come into play).

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