Pricing of Online Advertising: Cost-per-Click-through vs. Cost-per-Action

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Abstract
Today’s online advertising contracts tie online advertising payments directly to campaign measurement data such as click-throughs and purchases. This paper applies the economic theory of incentive contracts to the study of these pricing models and provides potential explanations as to when and how CPC (cost-per-click-through) and CPA (cost-per-action) pricing models should be used. We argue that using CPC and CPA models appropriately can give both the publisher and the advertiser proper incentives to make non-contractible efforts that may improve the effectiveness of advertising campaigns. It also allows the publisher and the advertiser to share the risk caused by uncertainty in the product market. Our research discovers various factors that can influence the usage of CPC and CPA models.

1. Introduction

“Half the money I spend on advertising is wasted. The problem is that I don’t know which half it is.”

Attributed to Lord Lever, founder of Lever Brothers

The Internet has emerged as an important medium for advertising. According to Interactive Advertising Bureau’s recent report, U.S. advertisers spent $23 billion on online advertising in 2008. Jupiter Research found that online advertising accounted for 8 percent of total U.S. advertising spending in 2008, and they forecasted that this percentage will grow to 14 percent by 2013. (Kerstetter 2008)

While there is no doubt about the future of the Internet as an important advertising medium, there has been much confusion on which pricing model should be used. In the early days of online advertising, online advertisers and publishers have simply borrowed the widely used CPM (cost-per-thousand-impressions) pricing model that is the standard in traditional media advertising. In this model, every time an advertisement is displayed, the publisher can collect money from the advertiser. It does not matter if consumers notice it, let alone interact with it.

More recently, both advertisers and publishers have started to realize that the Internet is a much more accountable and measurable medium than traditional media. After a consumer request a page from the publisher that contains advertisements, the consumer might then click on an advertisement, resulting in a click-through. Beyond this point, the consumer leaves the domain of the publisher and enters the advertiser’s web site. When interacting with the advertiser’s web site, the consumer might perform certain actions that are valuable to the advertiser, such as filling out a form, registering at the web site, or purchasing a product. Internet publishers and advertisers can track how consumers respond to online advertisements via various interactivity metrics, such as click-throughs and purchases (Interactive Advertising Bureau 2002)

These tracking metrics have enabled performance-based pricing models that let the advertiser pay more for advertisements that perform well and pay less for advertisements that do not perform.

Currently there are two performance-based pricing models that are widely used. The first model is called a CPC (cost-per-click-through) model. Under this model, the publisher receives a payment for each click-through that has occurred. Leading portals such as Google and Yahoo all sell their advertising spots linked to sponsored search results via the CPC model. The second model is known as a CPA (cost-per-action) model. Under this model, the publisher receives a payment from the advertiser for each action that has occurred and can be traced to advertisements delivered by the publisher. Such an action can be defined as either an online registration, a sales lead generated, or an online purchase. The CPA model is now used by many publishers. Even Google has started to use this model on their AdSense advertising platform (Helft 2007).
There are many distinctions between CPC and CPA models. First, an action needs to be reported by the advertiser, while a click is measured by the publisher. Second, an action takes place outside the scope of control of the publisher (Mahdian and Tomak 2007). Third, a click happens instantaneously, while an action such as buying a product might take days or even weeks after the consumer sees the advertisement. At the same time, neither the CPC model nor the CPA model is a perfect pricing model, and each model faces its unique challenges in industry practices. This is because there are a lot of uncertainties in the measurement of clicks as well as in the measurement of actions. In addition, using these pricing models may change the incentives for the publisher and the advertiser to make efforts that can improve the effectiveness of the advertising campaign. Thus, it is not clear which model should be used in the online advertising industry.

As the CPC and CPA pricing models emerge, the online advertising industry is engaged in a debate over which pricing model should be used. Should the industry stick to the traditional CPM model, or should the industry use these CPC and CPA models (see Digitrends 2001 and Meskauskas 2001)? Under what scenarios should the CPC model be used? Under what scenarios should the CPA model be used? In this paper, we apply a formal model to these questions and provide potential explanations as to when and how incorporating CPC and CPA models into online advertising deals can be profitable. We argue that both online publishers and advertisers can make non-contractible efforts that may improve the effectiveness of advertising campaigns. However, these efforts are costly to publishers and advertisers. Thus, by using CPC and CPA models appropriately, both publishers and advertisers can be given proper incentives to make these efforts. In addition, using CPC and CPA models appropriately also reduce the risks associated with these models to optimal levels for both publishers and advertisers. Our analyses uncover some key factors that influence the use of CPC and CPA pricing models. Such factors include the importance of the publisher’s efforts, the importance of the advertiser’s efforts, the precision of click-through measurement, the uncertainty in the product market, the risk aversion parameters, and the existence of non-immediate purchases.

The remainder of the paper proceeds as follows. Section 2 reviews the related management and economics literature. Section 3 develops a model of the publisher, advertiser, and advertising campaign measurement. Section 4 discusses our analyses and results to explain why and how CPC and CPA models should be used and examine what factors may affect their use. Section 5 concludes with some broader implications.

2. Literature Review

In the marketing literature, research on online advertising has primarily focused on banner advertising (Hoffman and Novak 2000, Chatterjee, Hoffman, and Novak 2003). Early research analyzes the effectiveness of banner advertising as a function of a variety of metrics, such as click-through rate using experiments or surveys (Cho, Lee, and Tharp 2001, Gallagher, Foster, and Parsons 2001, Dreze and Hussheer 2003). Ifeld and Winer (2002) use site-level data to analyze how to optimize advertising spending. Sherman and Deighton (2001) also use site-level data to study how to optimize placement of ads. Despite the dominance of banner ads in online advertising in the early stage, they often generate low click-through rate (Dahlen 2001, Dreze and Hussheer 2003), sometimes called “banner blindness”. Danaher and Mullarkey (2003) find that goal-oriented web users are less likely to recall banner ads than web surfers. Cho and Choen (2004) also provide explanations of why people avoid banner advertising. Moreover, using empirical data researchers investigate the association between the observed history of visits with clicks and conversion. For example, Moe and Fader (2003) develop an individual-level probability model to incorporate different forms of customer heterogeneity and study the impact of visit effects and purchasing effects on conversion. They find that both effects contribute to conversion. Similarly, Chatterjee, Hoffman, and Novak (2003) examine how click-through rates are influenced by banner ads exposure. Manchanda et al (2006) further studies the effect of banner advertising on actual purchasing patterns. Their findings suggest that the number of exposure, number of Web sites, and number of pages all positively influence repeat purchase probabilities.

Only recently have researchers started to study paid search advertising. One stream of literature focuses on the auction design in paid search advertising. Edelman, Ostrovsky, and Schwarz (2007) term the auctions used by Google and Yahoo “Generalized Second-Price Auctions” (GSP), since the standard second-price auction is a special case of GSP. They find that truth-telling is not an equilibrium of GSP, and they derive other properties of GSP. Varian (2007) obtains similar results to the ones in Edelman, Ostrovsky, and Schwarz (2007). Katona and Sarvary (2008) find that the difference in click-through rates across advertisers can influence the
advertiser’s bidding behaviors and the pricing of paid placements. Balachander and Kannan (2006) compare several different pricing models and derive managerial implications for advertisers and publishers. Other papers that also study the auction design in paid search advertising include Aggarwal, Feldman, and Muthukrishnan (2006), Chen, Liu, and Whinston (2008), and Liu, Chen, and Whinston (2008).

The second stream of literature on paid search advertising integrates auction design with consumer search. For example, Weber and Zheng (2002) study early search related advertising in a vertically differentiated product market. Chen and He (2006) introduce a product differentiation model to analyze sellers’ bidding strategies. Both papers build their models based on the search theory and emphasize consumers’ interactions with search engines. Athey and Ellison (2008) derive results on the advertisers’ bidding strategies and consumer search strategies, as well as the division of surplus between consumers, search engines, and advertisers.

There is an emerging stream of research that empirically studies paid search advertising. Rutz and Bucklin (2007), for example, investigate the performance of individual keywords by building a model that measures conversion probabilities conditional on click-throughs. In a related paper, Ghose and Yang (2007) study the impact of the attributes of key word advertisements on the click-through rate.

Despite the growing literature on paid search advertising, we are aware of no published research in marketing that study the pricing models of online advertising in the framework of incentive problems. The principal-agent models with moral hazard (Holmstrom 1979, Holmstrom and Milgrom 1987, 1991) have been applied to the study of incentive contracts in the context of agricultural sharecropping (see Allen and Lueck 1992 for a review), retail franchising (e.g., Lafontaine and Slade 1996), executive compensation (see Murphy 1999 for a review), sales-force compensation (e.g., Banker, Lee and Potter 1996), and customer satisfaction incentives (e.g., Hauser, Simester and Wernerfelt 1994).

However, most of the papers that have studied incentive contracts in various contexts consider contracting problems between a firm and its employees. Thus they use a restricted version of the model in Holmstrom and Milgrom (1987) that assumes that the principal is risk neutral (the agent is still risk averse), partly for simplicity and partly because of the belief that individuals are usually more risk averse than firms. However, the assumption that the principal is risk neutral will both distort the optimal contract by having the principal shoulder most of the risks, and prevent the study of how the principal’s risk aversion affects the optimal contract. We consider the contracting problem between an advertiser and a publisher, both being firms. Thus we use a more general version of the model suggested by Holmstrom and Milgrom (1987) that allows both parties to be risk averse. Using this more general model allows us not only to obtain an undistorted optimal contract, but also to study how the principal’s risk aversion affects the optimal contract. Such results have not been obtained in the existing literature.

3. A Model of Publisher, Advertiser, and Campaign Measurement

In our model, we focus on two entities that are involved in an online advertising contract: an online advertiser and a web content publisher. The advertiser sells a product (or service) to consumers through the online channel. In order to boost its sales, the advertiser launches an online advertising campaign by designing an advertisement and contracting with a web publisher so that the web publisher would deliver its advertisement to consumers who may be interested in the product it sells. An impression is defined as an instance of the advertisement being served to a consumer’s browser. Every time the advertisement is served to a consumer’s browser, the consumer may choose to ignore the advertisement, or to click on the advertisement and be taken to the advertiser’s store, which we refer to as a click-through. If the consumer is taken to the advertiser’s online store, the consumer may make a purchase, or leave without making a purchase. Click-through rate is defined as the ratio of click-through to impressions, and purchase rate is defined as the ratio of purchases to impressions.

The Publisher’s Efforts

The publisher can make efforts (decisions and actions) to improve the effectiveness of the advertising campaign. Some of these efforts are contractible. For example, the publisher can experiment with the size, background color, animation style, and placement of the advertisement in the content page and find a combination that attracts the most attention of consumers. These efforts—an advertisement’s size, placement, and rotation schedule—are usually stipulated in the contract between the advertiser and the publisher.
However, a lot of the publisher’s efforts are non-contractible. For example, whether the publisher closely associates the advertisement with its surrounding content and whether the publisher chooses appropriate wording in its pitch to consumers both affect the advertisement’s effectiveness. More importantly, the publisher can serve the advertisement to consumers who are the most likely to be interested in it by using a targeting technology based on its knowledge of consumers’ demographics, geographical location, expressed interests and other information. (Needham 1998, Maislin 2001) These efforts are either non-observable or too expensive and too difficult for the advertiser to observe and monitor. Aside from the difficulty and cost of direct monitoring, it may be in the advertiser’s best interest to give the publisher some freedom to make decisions and actions, because of the publisher’s better knowledge of consumers who visit its website. We focus on these non-contractible efforts.

It is worth noting that the publisher’s efforts that we focus on are incremental efforts above and beyond what the publisher will make without incentives. We assume that click-through rate is a linear function of the publisher’s efforts, and we model the impact of standard efforts on click-through rate as a positive intercept. The influence of other factors on click-through rate is modeled as uncertainty, which is distributed normally with a mean of zero. Formally, we have:

$$\theta_p = \alpha_p + \beta_p e_p + \gamma_p e_a + \varepsilon_p, \quad \alpha_p > 0, \quad \beta_p > 0, \quad \gamma_p > 0,$$

where $\theta_p$ is the click-through rate, $e_p$ is the publisher’s efforts, and $\varepsilon_p$ is a random error that is distributed normally with a mean of zero and a variance of $\sigma_{\varepsilon_p}^2$.

**Utilities**

Incremental efforts are costly to the publisher and advertiser, and become more costly as total effort level increases. We model the publisher’s cost of incremental efforts by a quadratic cost function that is widely used in the literature of incentive contracts. We assume that the publisher acts in its own best interest of the advertiser and that of the publisher are misaligned under a pure CPM model. We model the publisher’s cost of incremental efforts by a quadratic cost function that is widely used in the literature of incentive contracts. Formally, the cost of the publisher’s efforts is:

$$C(e_p) = \frac{\varepsilon_p^2}{2}.$$

At the same time, the advertiser’s efforts are costly to the advertiser, and become more costly as total effort level increases. We also model the advertiser’s cost of efforts by a quadratic cost function. Formally, the cost of the advertiser’s efforts is:

$$C(e_a) = \frac{\varepsilon_a^2}{2}.$$

Different performance-based contracts (either CPC or CPA) expose both parties to different uncertainties. On the one hand, when the payment from the advertiser to the publisher is tied to click-throughs, both parties are exposed to the random noise in the measurement of click-through rate — when click-through rate is unexpectedly high and not
all the customers who are directed to the advertiser are necessarily the potential prospects for the advertiser, a contract with per-click-through payment can send costs through the roof and break the advertiser’s budget. Moreover, the advertiser incurs unnecessarily high selling costs without generating enough revenue. For example, when the Tony Blair, the British prime minister was in the center of the public for his scandal in 2005, many people searches a name “Blair” and Google shows the paid search link “Blair.com” for grocery store. Many people mistakenly clicks on the link since it is shown on the first line of the first page, the company simply paid $200,00 for advertising without generating any single sales on that particular date. In parallel, when the advertising payment is tied to purchases, both parties are exposed to the uncertainty in the product market—when sales are unexpectedly low in spite of the high click-through rate, the publisher loses advertising revenue in spite of their high efforts to increase the click-through rate of directing the right prospects to the advertiser. The publisher is concerned about the free riding of advertiser who just enjoys the high publicity without paying enough advertising fee.

Due to all the uncertainties mentioned above, we must consider the publisher’s and advertiser’s risk aversions. We assume that both the publisher and the advertiser have exponential utility with CARA (constant absolute risk aversion) parameters. Formally, the publisher’s utility is
\[ u(y_p) = 1 - \exp(-r_p y_p) \]
where \( y_p \) is the publisher’s payoff and \( r_p \) (\( r_p > 0 \)) is the publisher’s risk aversion parameter. The advertiser’s utility is
\[ u(y_a) = 1 - \exp(-r_a y_a) \]
where \( y_a \) is the publisher’s payoff and \( r_a \) (\( r_a > 0 \)) is the publisher’s risk aversion parameter.

**Timeline**

At the first stage, the advertiser offers a contract to the publisher. At stage two, the publisher can decide to accept the contract, or to decline the contract in which case it obtains a utility of zero and the game is over. Finally, at the third stage, if the publisher accepts the contract, the advertiser decides the level of its incremental efforts and the advertiser decides the level of its incremental efforts. Finally, the advertiser and the publisher observe the click-through rate or purchase rate depending on the contract, and obtain utilities based on the result of this advertisement.

**4. Analyses**

**The Optimal Contract**

In principle, an advertising contract could be any function of click-through rate and purchase rate. Fortunately, our mathematical formulation implies that the optimal contract is a linear function of these two variables (Holmstrom and Milgrom 1987). This result follows from our assumptions that random noise in the measurement of click-through rate and uncertainty in the product market both conform to normal distributions and that the advertiser and the publisher both have exponential utility with constant absolute risk aversion. Holmstrom and Milgrom (1987) show the linear contract result under the assumption of normal distribution and constant risk aversion, and Banker and Datar (1989) identify necessary and sufficient conditions for other formulations to have linear optimal contracts. Although the exact linearity of the optimal contract depends on technical assumptions (for example, normal distribution and exponential utility), the linear contract is a good approximation to a variety of incentive contracts. More importantly, linear contract, because of its simplicity, is the most widely used form of contract in online advertising (Hoffman and Novak 2000a).

We first solve for the optimal contract and then analyze why performance-based models (CPC and CPA) should be used in the contract between the advertiser and the publisher. The optimal contract will include a guaranteed fixed payment to the publisher for each impression, \( t_m \), a per-click-through payment, \( t_c \), and a per-purchase payment, \( t_p \). Under this contract of \((t_m, t_c, t_p)\), the publisher can expect to receive from the advertiser, for each impression delivered, a payment of \( t_m + t_c \theta_c + t_p \theta_p \), if click-through rate is \( \theta_c \) and purchase rate is \( \theta_p \).

Solving our analytical model gives us the optimal contract. Formally, we have:

\[
\begin{align*}
\theta_c^* &= m \frac{[\beta_r^2 + (r_a + r_p)\sigma_{ac}]r_a \sigma_{dp} + \beta_r^2(r_a + r_p)\sigma_{ac}}{[\beta_r^2 + (r_a + r_p)\sigma_{ac}][(r_a + r_p)\sigma_{dp} + \gamma_p^2] + \beta_r^2(r_a + r_p)\sigma_{ac}}, \\
\theta_p^* &= m \frac{(r_p \sigma_{dp} + \gamma_p^2)\beta_p}{[\beta_r^2 + (r_a + r_p)\sigma_{ac}][(r_a + r_p)\sigma_{dp} + \gamma_p^2] + \beta_r^2(r_a + r_p)\sigma_{ac}}.
\end{align*}
\]

Next we study how these performance-based elements should be used by examining how the optimal contract is affected by various factors.
**Should CPC and CPA Elements Be Used?**

PROPOSITION 1. The advertiser obtains a higher utility by including CPC and CPA elements, in addition to a CPM element, in its contract with the publisher, as opposed to using only a CPM element (i.e., $t_y^*$ and $t_y^*$ are positive).

Due to the limit of space, the proofs of this proposition and other propositions are not included, but they are available upon request. To understand this proposition, let us first consider the case of a pure CPM contract. Under this contract, the publisher has no incentives to make incremental efforts. As a result, the advertising campaign is unlikely to be very effective, and the advertiser will not achieve high sales and a high utility. However, under a contract that includes CPC and CPA elements, the publisher has incentives to make incremental efforts that may improve the effectiveness of the advertising campaign. Including CPC and CPA elements in the contract between the advertiser and the publisher increases the sum of the advertiser’s utility and the publisher’s utility.

**How Should CPC and CPA Elements Be Used?**

The optimal contract places positive weights on both click-through rate and purchase rate—two signals of the publisher’s incremental efforts. This result follows from Holmstrom (1979)’s informativeness condition. In our model, neither click-through rate nor purchase rate is a sufficient statistic for the pair of them. Therefore, both should be used in the optimal contract. In addition, the weight placed on a signal depends on its precision. An increase in the precision of a signal leads to an increase in the weight placed on that signal. This rule also applies to our model.

PROPOSITION 2. If click-through rate is measured with greater precision, a) the optimal contract places a greater weight on click-throughs and a smaller weight on purchases, and b) the advertiser obtains a higher utility (i.e.,

$$
\frac{\partial t_y^*}{\partial \sigma_{p^*}} < 0, \frac{\partial t_y^*}{\partial \sigma_{c^*}} > 0, \frac{\partial u(y_c)}{\partial \sigma_{c^*}} < 0.
$$

Our analysis shows that click-through rate should not be relied heavily upon if it is a very imprecise measure or is exposed to a lot of randomness, because this exposes the advertiser and the publisher to high risks. For example, the click-through rate on the key word “Blair” is subject to a lot of random noise. Thus, advertisers and publishers should try to use other measures in their online advertising contracts. In addition, this proposition helps explain the efforts over the past few years by industry practitioners to obtain a more precise measure. When the cost-per-click pricing model was first introduced, there was no uniform standard on the definition of click-through rate. Some publishers, in order to inflate their click-through rate, used various tricks like displaying input boxes that are really pictures to deceive people into clicking. This action made click-through rate an unreliable measure of the publisher’s incremental efforts. Since then, the online advertising industry has started to standardize advertising measurement and to use other interactivity metrics to refine the measurement of click-through rate (Interactive Advertising Bureau 2002). These efforts aimed at obtaining a standard and more precise measurement of click-through rate can facilitate the use of CPC model and can make both the advertiser and the publisher better off.

PROPOSITION 3. As uncertainty in the product market decreases, a) the optimal contract places a greater weight on purchases and a lower weight on click-throughs, and b) the advertiser obtains a higher utility (i.e.,

$$
\frac{\partial u(y_p)}{\partial \sigma_{p^*}} < 0, \frac{\partial t_y^*}{\partial \sigma_{p^*}} > 0, \frac{\partial u(y_c)}{\partial \sigma_{c^*}} < 0.
$$

Our analysis shows that purchase rate can be relied more heavily on if uncertainty in the product market decreases. The intuition is that, as uncertainty in the product market decreases, purchase rate becomes a more accurate signal of the publisher’s incremental efforts, and relying on a more accurate signal exposes the advertiser and the publisher to smaller uncertainty and lower risk. This proposition also sheds light on what products are good candidates for deals that tie advertising payments to purchases. According to this proposition, products that are suitable for these cost-per-action (CPA) deals are products that are mature, have steady and predictable sales, have a low level of market uncertainty, and are suitable for online shopping. In contrast, these deals are not suitable for products that are new and unproven or products that are not suitable for online shopping, unless there is a mechanism that can limit these products’ uncertainty. The online advertising industry shares our view on this problem, and has taken actions to limit products’ uncertainty. For example, Affiliate Fuel, a CPA advertising network, requires all new advertisers to run a test campaign before they can enter a larger scale contract (Affiliate Fuel 2003). Similar ideas of providing historical data on an advertiser’s past advertisements and performing an upfront test before entering a larger CPA deal are expressed in Digitrends (2001) and Hallerman (2002).

**Risk Aversion Parameters**

Although tying advertising payments to purchases shifts uncertainty from the advertiser to the publisher,
tying advertising payment to click-throughs adds uncertainty to both parties’ payoffs. These two signals—purchases and click-throughs—have different properties, as a result, they should be used differently in the optimal contract. Next we study how risk aversion parameters affect the use of CPC and CPA models.

**Proposition 4.** a) The optimal per-purchase payment increases as the advertiser becomes more risk averse, and it decreases as the publisher becomes more risk averse (i.e., $\frac{\partial t_p^*}{\partial r_a} > 0, \frac{\partial t_p^*}{\partial r_p} < 0$). b) The optimal per-click-through payment decreases as the advertiser becomes more risk averse (i.e., $\frac{\partial t_c^*}{\partial r_a} < 0$).

However, the relationship between the optimal per-click-through payment and the publisher’s risk aversion parameter is inverted-U-shaped.

A higher per-purchase payment from the advertiser to the publisher means the publisher shoulders a larger proportion of the risk caused by uncertainty in the product market. This becomes more desirable as the advertiser becomes more risk averse, and less desirable as the publisher becomes more risk averse.

However, a higher per-click-through payment would expose both the publisher and the advertiser to a higher level of risks associated with the measurement of click-throughs. This becomes less desirable as either the advertiser or the publisher becomes more risk averse. But we also have to consider whether the publisher is given enough incentives to make incremental efforts. In the case of the advertiser becoming more risk averse, the publisher will be given a higher per-purchase payment that translates to a higher level of incentives. Thus, the incentive consideration is unnecessary in this case, and the optimal per-click-through payment decreases. In the case of the publisher becoming more risk averse, the advertiser will be given a lower per-purchase payment that translates to a lower level of incentives. Thus, the incentive consideration becomes effective, and the balancing of the incentive consideration and the undesirability of using per-click-through payment leads to an inverted-U-shaped relationship between the publisher’s risk aversion and the optimal per-click-through payment.

**Non-immediate Purchases**

In the basic model, we assume that a consumer who sees the advertiser’s offer will either make an immediate purchase, or make no purchase and forget the offer. In reality, there could exist non-immediate purchases. First, non-immediate purchases can be significant for products that have high value or products that are difficult to be evaluated, such as cars and electronics. A study cited by Briggs (2003) shows that an advertiser gets 80 percent of its conversions from these returning consumers. Second, some products, for instance, medicines, office supplies, and insurance policies, feature high repeat purchase rates. Consumers usually go directly to the advertiser’s store when making repeat purchases. These repeat purchases can also be thought of as non-immediate purchases and can be a significant part of the total purchases.

**Proposition 5.** The optimal CPA payment is higher when non-immediate purchases exist, as opposed to when non-immediate purchases do not exist. However, the optimal CPC payment is independent of non-immediate purchases.

The intuition is as follows. The advertiser benefits from non-immediate purchases just as it does from immediate purchases. However, since the publisher does not get credit for these purchases, the old optimal contract, if it were used, would not have given the publisher enough incentives to make incremental efforts. In order to solve this problem, the new optimal contract should give the publisher full credit for non-immediate purchases, while the CPC payment is kept intact.

It is worth noting that the online advertising industry is evolving in a direction of giving the publisher credit for non-immediate purchases. When CPA pricing model was introduced, the publisher got per-purchase commission only for purchases that happen immediately after a consumer’s click-through. Recently, many advertisers have started to give the publisher longer commission duration—the amount of time the publisher can receive commission for a purchase after a consumer has first clicked-through (see Commission Junction 2003, Franco and Miller 2003).

**5. Conclusions**

The Internet is a much more accountable and measurable medium than traditional media. The rich performance metrics available on the Internet have enabled pricing models that tie online advertising payments directly to campaign measurement data such as click-throughs and purchases. These pricing models have become increasingly widely used in the online advertising industry. This paper attempts to provide a formal structure to analyze issues related with these CPC and CPA pricing models.

More specifically, we focus on the efforts that the publisher and the advertiser can make to improve the
effectiveness of advertising campaigns, and we define measurement data such as click-throughs and purchases as noisy signals of these efforts. Using well-established premises and a simple model, we provide an explanation of why and when CPC and CPA pricing models are desirable. An online advertising contract that includes appropriate CPC and CPA elements gives the publisher and the advertiser proper incentives to make their efforts, and helps align the interests of the publisher and the advertiser. We use this model to explore factors that may influence the use of CPC and CPA pricing models and to clarify issues that are being debated in the industry.

There are a variety of ways our results can be extended by future research. First, we only analyze the incentive contract problem between one advertiser and one publisher. Researchers may explore cases that have oligopoly players. Second, it may be interesting, but perhaps technically challenging, to make extensions to different utility functions, nonlinear mappings from efforts to click-throughs, and nonlinear mappings from efforts to purchases. Some of these extensions can be analyzed in the context of a linear contract between the advertiser and the publisher, but others may require nonlinear contracts. Finally, this paper has a number of propositions that predict how the use of CPC and CPA pricing models is influenced by various factors such as the importance of the publisher’s efforts, the importance of the advertiser’s efforts, the precision of click-through measurement, the uncertainty in the product market, the risk aversion parameters, and the existence of non-immediate purchases. We have not empirically tested these hypotheses in this paper. It would be interesting to have these propositions tested using empirical data.

6. References


