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ABSTRACT

The current study examines the driving forces behind enterprise software providers' adoption of the subscription-based pricing model. I identify and model two special features of enterprise software products: consumers' uncertainty about their true valuations for the product prior to adoption and the high upfront implementation cost. I develop a dynamic model with an infinitely-living monopoly software vendor and overlapping generations of consumers. The results show that in a steady state, when consumers know their true valuations, the three licensing formats, pure selling, pure leasing (subscription-based) and concurrent selling and leasing, are equally profitable. When uncertainty exists, however, any one of the three licensing formats could be optimal depending on the magnitude of the implementation cost, demand distribution and the accuracy of the signal. The results offer interesting insights into the emerging adoption of the subscription-based pricing strategy. Future directions are discussed at the end.

Keywords

Software pricing, software subscription, software as a service.

INTRODUCTION

On February 2nd, 2006, Europe's biggest software provider, SAP, made its first push into the on-demand CRM market, and hence became the last to join Microsoft, Oracle and the other top enterprise software providers in the emerging market of hosted software services. Is this the end of software as we know it? In 2005, product sales still represented about 80% of the total revenue in the software market. However, the picture has been undergoing dramatic changes in the past few years. Many large software vendors, such as Computer Associates and Sun Microsystems, enrich their traditional selling model with more flexible subscription-based pricing. Vendors such as Oracle and Salesforce.com go one step further, and offer a subscription model that bundles the software, hardware, and support services (the on-demand model). The trend is gaining so much momentum that Merrill Lynch software analysts have devised a new method of assessing and valuing software companies, On-Demand Index, which accounts for the growth in deferred revenue that results when vendors use the subscription-based pricing model. What are the driving forces behind the emerging transition?

Although the on-demand approach has the potential to win profit both from the software sales and from the operation of the software, the large software vendors mostly focus on the former and outsource the operation of the services. In other words, the subscription model is more similar to a software rental model than a service model for them. SAP has selected IBM as its hosting service partner for the first offering of on-demand solutions. Those who want to offer Microsoft CRM hosted service could pay Microsoft a monthly fee for each business user they enroll, and then resell the service at a profit. The rental market expands the large software provider's market share, but also cannibalizes their traditional product selling market. To explain the emerging transition, we need to better understand the underlying market.

The enterprise software market constitutes a special case of a "durable experience good" market in the absence of a second-hand market. In particular, I identify and model the following two features, which have been found to influence pricing: high upfront implementation cost, and consumers' uncertainty about their true valuations for the software prior to adoption.

Enterprise software implementation often requires significant upfront investment in purchasing hardware, hiring outside consultants to incorporate the software with other applications. Firms often spend over 100 million dollars to implement an ERP system (Robey et al, JMIS 2002). Brynjolfsson et al. (2002) find that for each dollar spent on a software product, an additional 9 dollars are needed for complementary tangible and intangible assets. Moreover, it is notoriously risky to implement enterprise software packages. Approximately one half of all ERP projects fail to achieve anticipated benefits

(Appleton, 1997); 25% of software projects are cancelled outright; and three-fourths of all large systems are "operational failures" (Gibbs, 1994).

Extensive research in the IS literature has been devoted to study the factors that influence the success of enterprise software implementations (Davis et al., 1989; Cooper and Zmud, 1990). However, large uncertainty surrounds the measurement of the factors identified and considerations of the other contextual factors that also potentially influence an organization's benefit from its investment in a software product (Cooper and Zmud, 1990).

To study the special challenges in the software industry, I develop a dynamic model which incorporates the effects of heterogeneity of customer types, up-front implementation costs, prior customer uncertainty about the value of the software, and the possibility of dynamic pricing with successive generations of new potential customers (the so-called "overlapping generations model"). The current study represents the first attempt to theoretically explain the emerging transition of pricing strategies in the enterprise software industry by modeling the interplay of the variables that have been found to influence the underlying changes. I start with a benchmark model where consumers know their true valuations for the software upfront, and then include consumer valuation uncertainty in the model. I solve for the optimal pricing strategies in a steady state in both cases.

LITERATURE REVIEW

Limitation of space prevents a comprehensive review, but here are some key references. The current study contributes to three lines of literature:

(1) Pricing of durable goods: Economic theorists have found selling less profitable in a monopolistic environment due to a seller's inability to commit to production restrictions (hence keeping a high price) in the future (Coase, 1972; Bulow, 1982; Stokey, 1981). Leasing is a more profitable choice as it allows the seller to credibly keep a high price over time. (2) Inter-temporal price discrimination: Stokey (1979) shows that with continuous time, even if the monopolist is able to pre-commit to a price path, the optimal pricing strategy involves the monopolist only selling in the first period. Salant (1989) shows that the results in Stokey (1979) follow from the linearity of the constraint. Conlisk et al (1984) find cyclic pricing at equilibrium with an inflow of new consumers. (3) Leasing or selling software products: In a two-period game setting, Choudhary et al (1998) find that introducing leasing in period one (together with selling) increased the seller's profit when network externalities are present. Seidmann and Zhang (2002) look into a vendor's pricing decision when customers are uncertain about the quality of the future upgraded version. They show that by implementing concurrent selling and leasing, a vendor could effectively segment the market. In a more related study, Seidmann and Ma (2004, 2005) model the competition between enterprise software vendors and ASPs, which offer software subscription services online. They find the two types of vendors segment the market at equilibrium. The market share depends on the magnitude of the integration cost (2004) and the switching cost (2005).

MODEL

I consider a standard discrete time overlapping-generation model with two-period-living consumers (representing firms) and one infinitely-living monopolistic software vendor. In each period, a unit mass of new consumers enters the market, which is indexed by a type parameter *v*. This type *v* represents the gross utility the consumer derives from using the product for one period. There are two types of consumers: a fraction β of the consumers are of high type with $v = v_H$, and a fraction $1-\beta$ are of low type with $v = v_L$ ($v_H > v_L$). In the benchmark model, consumers know their true types, but the software vendor does not. Each consumer must pay a one-time fixed implementation cost c ($c \le v_L$) to realize the value of the product. There is no further adjustment cost in the future period, if applicable. The common discount factor is δ, and the marginal cost of production of the software is constant at zero.

In the full model, consumers' true valuations for the software (or types) are unknown to them before they adopt the product. Nevertheless, each consumer receives a noisy signal *y* about her/his type at the beginning of her/his age 1, where $y = v_H$ or v_L. With probability α, the signal is the same as the consumer's true valuation, and with probability 1-α, the signal is wrong. Without loss of generality, I assume α >max(β,1-β). A consumer only learns about her/his true type after using the product for one period. The seller can identify their previous customers. The rest of the setting is the same as in the benchmark model.

The timing of the game is as follows:

- At the beginning of each period, the monopolist seller announces:

(Leasing case) Two leasing prices: one for the first-time adopters and one for the second-time adopters.
(Selling case) One selling price for all consumers.
(Concurrent selling and leasing case) All three prices.

Consumers observe the prices and make a purchase decision anticipating their total payoff. Leasing only gives a consumer access to the software for one period, while buying gives them access for 2 periods.

RESULTS

I start with a benchmark model in which each consumer knows her/his true valuation for the software upfront (no uncertainty). Then I will show how uncertainty changes the results. In both cases, I will solve for the steady state equilibrium, in which the monopolist commits to a pricing strategy (both licensing format and price(s)) that does not change over time.

Benchmark Model

The utility that a type v user can derive from the software is $v-c$ in the initial period, and v in the following period. Since the prices do not change over time in a steady state, if a consumer does not adopt (buy or lease) the software at age 1, s/he will not do so at age 2 either. Also, in one period if a consumer with $v=v_L$ finds it optimal to adopt (either buy or lease), then all consumers of the same age with $v=v_H$ must find it optimal to adopt (either buy or lease), too.

The comparison among the three pricing strategies (selling, leasing or concurrent selling and leasing) are relatively straight-forward. The results show that when consumers know their true types, in a steady state, the optimal price(s) under the three licensing formats (selling, leasing or concurrent selling and leasing) are equally profitable.

A Model with Consumer Uncertainty

When consumers are uncertain about their valuations for the software, their initial adoption decisions are based on their expected valuations for the software compared to the total adoption cost, given the noisy signal. They learn their true valuations for the software after implementing and using the software for one period. If the consumers leased the software initially, then they have an option at age 2 whether to renew the lease or not. They renew their leases only if their true valuations are greater than the lease renewal price. Given the consumers' decisions, the monopolist firstly solves for the optimal price(s) under pure selling, leasing or concurrent selling and leasing, and then compares among the three licensing strategies for the optimal pricing strategy.

The results show that when uncertainty exists, the optimal pricing strategy depends on the magnitude of the adjustment cost, the demand distribution, and the accuracy of the signal. When the adjustment cost is high, the optimal pricing strategy involves selling only to the consumers who receive the high type signal ($y=v_H$) in every period. Otherwise, if the signal is inaccurate and the high and low type consumers' valuations are very different, concurrent selling and leasing is the optimal pricing strategy. Under the optimal concurrent selling and leasing prices, consumers receiving the high type signal buy the software at age 1, and those receiving the low type signal lease the software at age 1 and renew at age 2 only if their true type is high type ($v=v_H$). This strategy allows the vendor to identify the high valuation consumers who receive the wrong signal by offering a low introductory leasing price, and then to extract maximum surplus from them at age 2. In the rest of the cases, selling to all consumers in each period is the optimal pricing strategy.

DISCUSSION AND FUTURE RESEARCH

The results offer interesting insights into why the transition of pricing strategies occurs simultaneously with the rise of web-based technologies. When the implementation cost is high, as in the case prior to the proliferation of web-based technologies, the optimal pricing strategy involves selling only to the high-end market, whose perceived valuation for the software is high. Offering subscription-based pricing is not profitable, since the seller would lower the prices too much to subsidize consumers' implementation costs and valuation uncertainty. The recent developments in web-based technologies enable delivery of software over the Internet, which significantly reduces the customers' initial implementation costs. This makes concurrent selling and leasing software a more profitable option as indicated in the model. Indeed, low up-front costs and risk-sharing have been cited as the most propelling reason for firms to adopt the on-demand subscription-based software offerings (Konary and Traudt, 2004).

The solution focuses on the case in which the seller commits to one pricing strategy that does not change in the customers' foreseeable future. This assumption is based on the observation that enterprise software vendors do not change their pricing

strategies often. Nevertheless, sellers in real-life may have more freedom in choosing different pricing strategies over time. Hence one immediate extension would be to allow the monopolist to choose different pricing strategies over time. By relaxing this constraint, the model results would have the potential to shed light on the future structure of the enterprise software market.

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