From Product- to Service-Oriented Strategies in the Enterprise Software Market

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1 Introduction

The recent surge of subscription-based software offering, as an alternative to the traditional product-selling model, has attracted wide attention, especially the web-based on-demand model. In February 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 for on-demand software services. IDC predicts that revenue from subscription licensing will grow at 16.6% annually from 2004-2008, and reach $10.7 billion by 2009. The trend is gaining so much momentum that Merrill Lynch software analysts have come up with a new method of assessing and valuing software companies, On-Demand Index, which takes into account the growth in deferred revenue that results when vendors use subscription-based licensing.

This transition can have a far-reaching influence for the whole IT industry. The outsourcing service providers, software integrators, enterprise hardware vendors, among others, are all at the forefront of the challenges brought by the transition. To act strategically, it is crucial for firms to understand what are the driving forces behind the transition, and how it restructures the market. The current study asks the following questions:

1. Why did large software vendors sell only to the high-end market in the pre-on-demand era?

2. Why are these vendors changing their optimal pricing strategy now?

3. What is going to be the future of the enterprise software market? Will the on-demand model dominate the market?

I identify and model two features of the enterprise software market: 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, and 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, 2002). Brynjolfsson et al.(2002) find that for each dollar spent on a software product, an additional 9 dollars value is created by complementary tangible and intangible assets. Moreover, it is 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).

The web-based on-demand model significantly reduces the upfront implementation cost by centralizing the resources required for implementation on the vendor's side. Indeed, anecdotal evidences from numerous industry studies suggest that reduced upfront payment requirements and risk mitigation are two crucial factors that are driving the growth of the new pricing model.

I develop a dynamic model with an infinitely-lived monopoly software vendor and overlapping generations of consumers. Consumers do not know, but receive a signal about their true valuations for the software prior to adoption. There is a one-time cost involved with implementing the software. The results show that the pricing strategy in the pre-on-demand era is largely driven by the existense of uncertainty and the high implementation cost. As the implementation cost drops significantly in the on-demand approach, thanks to the advances in the new web-based technology, either a mixture of selling and on-demand model or pure on-demand model is optimal. I characterize the conditions that determine the market equilibrium in a steady state.

This study contributes to the literature on pricing of enterprise software. Space limitation prevents a comprehensive literature review. A complete list of references is available upon request. In particular, this work builds on the work of Bakos and Brynjolfsson (2000), Choudhary et al (1998), Seidmann and Zhang (2002), and Seidmann and Ma (2004, 2005). The current paper contributes to this literature in that it constructs the first theoretical model that addresses the dynamic change in the market equilibrium brought by the introduction of the on-demand model.

2 Model

I consider a standard discrete-time overlapping-generations model with two-period lived consumers and one infinitely lived monopolistic software vendor. In each period, a unit mass of new consumers come to the market, which are indexed by a "type" parameter v. This type v represents the gross utility a consumer gets from using the product for one period. There are two types of consumers: a fraction β of the consumers are "high types" with value $v = \overline{v}$, and a fraction $1 - \beta$ are "low types" with value $v = \underline{v}$ ($\overline{v} > \underline{v} > 0$). A consumer's true type is unknown to him before he adopts the product. Nevertheless, he receives a noisy signal y of his true type at the beginning of his age 1, where $y = \overline{v}$ or $\underline{v}$. With probability α the signal is the same as his type, and with probability $1 - \alpha$ the signal is wrong. Without loss of generality, I assume $0 < \beta < 1/2$ and $1 - \beta < \alpha < 1$. To use the software, each consumer has to pay a one-time implementation cost. Denote the implementation cost that firms incur when they buy and install the software on their own sites by c_s, and that in the case of software subscription (or leasing) by c_l. Before the on-demand model was available, $c_s = c_l$; afterwards, c_s stays the same and c_l is reduced. Furthermore, a consumer can only learn about his true type after using the product for one period. The consumers and the seller have the same discount factor, denoted by δ. The marginal production cost of the software is constant at zero. To make the results less trivial, I assume $\beta\overline{v} > \underline{v}$. The timing of the game is as follows:

- At the beginning of period t, the monopolist seller announces three prices: a selling price $p_{s,t}$, a leasing price $p_{l,t}$, and a lease renewal price q_t ($0 < q_t \leqslant \overline{v}$)[1].
- Consumers observe the prices, and make a purchase decision anticipating their total payoff.

[1] I treat pure selling and pure leasing as special cases of concurrent selling and leasing under which the leasing price or selling price is prohibitively high. I assume the monopolist cannot commit to the future lease renewal price.

Leasing only gives a consumer access to the software for one period, while selling gives them access for 2 periods (the length of a consumer's lifetime).

The monopolist can recognize his prior customers, but cannot tell a consumer's age unless he/she was a prior customer. Table 1 lists some notations:

Variable	Representation
ψ_{ij}	Conditional probability of $v = i$ given $y = j$, i.e. $\psi_{HL} = \Pr(v = \overline{v} \mid y = \underline{v})$
ψ^H, ψ^L[2]	ψ^H: Fraction of new consumers who receive signal $\overline{v}$; ψ^L: The same for signal $\underline{v}$
$E[v\|L]$	The expected utility of using the software for one period given $y = \underline{v}$.
$E[v\|H]$	The expected utility of using the software for one period given $y = \overline{v}$.

3 Steady-State Solutions

I start with a benchmark model in which each consumer knows his/her true valuation for the software (no uncertainty), but the seller does not. Then I will show how uncertainty changes the results. In both cases, I will solve for steady-state equlibrium, in which the monopolist charges a set of selling or leasing prices that does not change over time. In this case, the monopolist's optimization problem over the infinite time horizon is equivalent to that over each generation of consumers. The choice of steady-state solutions is not just a mathmatical simplification, but based on the observation that the pricing strategy in the enterprise software market tends to be stable over time. Accordingly, the steady-state solutions more closely resemble the market equilibrium in the long run, which is the focus of the study. Further extension to dynamic solutions is discussed at the end.

3.1 A Model without Consumer Uncertainty

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 in a steady state, the prices do not change over time, if a consumer does not adopt (buy or lease) the software at age 1, he will not do so at age 2 either. Also notice in any period if a consumer with $v = \underline{v}$ adopts (either buy or lease) the software, then all consumers of the same age with $v = \overline{v}$ must find it optimal to adopt (either buy or lease) too.

When the product is for sale only, a consumer's purchase decision depends on the overall adoption cost $p_s + c$, as compared to his valuation for the software $(1 + \delta) v - c$. When $\beta\overline{v} > \underline{v}$, the optimal pure selling price is $p_s = (1 + \delta) \overline{v} - c$, and the monopolist's average profit from one generation of consumers is $\pi = \beta ((1 + \delta) \overline{v} - c)$. Only consumers of type $v = \overline{v}$ buy the software in each period.

When the product is for lease only, a consumer of type v just entering the market leases the software if $v - c - p_l + \delta \max (v - Eq, 0) \geqslant 0$, where Eq denotes the consumers' expected lease renewal price in the next period. At age 2, a returning consumer of type v renews his lease if $v - q \geqslant 0$. Since $\beta\overline{v} > \underline{v}$, one can show the optimal lease renewal price is always $q = \overline{v}$, and, accordingly, the optimal first-time leasing price is $p_l = \overline{v} - c$. At equilibrium, only the consumers of type $v = \overline{v}$ lease the software in both periods. Pure leasing is as profitable as pure selling.

[2] Judd (1985) shows that there exists a probability measure on the realization of a continuum of i.i.d. draws such that the realization function is measurable with probability 1 and the law of large numbers holds with probability 1.

In the absence of consumer uncertainty, in a steady state, concurrent selling and leasing cannot do better than a combination of the optimal pure selling and pure leasing prices. Hence we have:

Theorem 1 *When consumers know their true types, the three licensing formats (selling, leasing or concurrent selling and leasing) are equally profitable.*

3.2 A Model with Consumer Uncertainty

In this section, I consider the case in which the consumers' true types are unknown to them before they adopt the product. I first solve for the optimal prices under each licensing format (selling, leasing or concurrent selling and leasing), and then compare the profitability of the three licensing formats. Due to space limitation, the math details are omitted here, but available upon request. I will characterize the optimal pricing strategy based on the resulting equilibrium market condition when the corresponding optimal prices are charged. One can show that the set of selling and leasing prices that can lead to these market conditions is unique. Let $x_1 = (1+\delta)\left(E[v|L] - \psi^H E[v|H]\right)/\psi^L$, and $x_2 = \left(E[v|L] + \delta(1-\alpha)\beta\overline{v} - \psi^H E[v|H]\right)/\psi^L$.

Theorem 2 *When uncertainty exists, the three licensing formats are not equally profitable. When $c_s = c_l$, if $c_s > \max(x_1, x_2)$, the monopolist's optimal pricing strategy is selling only to the consumers who receive signal $y = \overline{v}$.*

When uncertainty exists, pure leasing or concurrent selling and leasing could outperform pure selling. The reason is that under these licenses, the monopolist could offer an introductory leasing price to help the consumers learn their true types at their early age, and then get higher profit later on. By offering an introductory price, the monopolist earns less from the consumers who receive the high-type signal, but gains additional demand from the consumers who receive the low-type signal. When the implementation costs are equally high ($c_s = c_l > \max(x_1, x_2)$), the loss in revenue from the high-end market is not compensated by the gain in revenue from the additional demand, since their willingness to pay for the software is too low. Therefore, the monopolist's optimal strategy is to sell only to the high-end market, or the consumers whose perceived valuations for the software are high.

This senario closely resembles the market conditions in the pre-on-demand era. Back then, firms had to work out the same implementation on their sites, no matter whether they were paying for the software on a perpetual base or subscription base, hence $c_s = c_l$. As discussed early in the introduction, the implementation cost was prohibitively high. The resulting market condition was that the majority of the low-end market was left out of the market coverage.

The web-based on-demand model delivers the software service over the internet on a subscription base. It requires far less upfront implementation cost on the clients' side as compared with the traditional model. To model how this change shifts the market equilibrium, I will take the above condition ($c_s > \max(x_1, x_2)$) as given, and examine how a reduction in c_l changes the monopolist's optimal pricing strategy in a steady state. To simplify notation, let $r = \underline{v}/\overline{v}$, $x_3 = \max\left\{c_s\psi^H + x_2\psi^L, c_s - \delta\psi_{LH}\underline{v}\right\}$, $x_4 = x_2 + \delta(1-\alpha)(1-\beta)\underline{v}/\psi^L$, and $\lambda = \max\left\{c_s - \delta\psi_{LH}\underline{v}, c_s\psi^H + x_2\psi^L - \delta(1-\alpha)(1-\beta)\underline{v}\right\}$.

Theorem 3 *When $c_s > \max(x_1, x_2)$, the monopolist's optimal strategy depends on the demand distribution r and the magnitude of c_l : When $0 < r < \psi_{HL}$, the monopolist's optimal strategy* *is: 1) Selling only to the consumers who receive signal* $y = \overline{v}$ *if* $x_3 < c_l < c_s$*; 2) Leasing only to the consumers who receive signal* $y = \overline{v}$ *and a future lease renewal price* $q = \overline{v}$ *if* $x_4 < c_l < x_3$*; 3) Concurrent selling and leasing: selling to the consumers who receive signal* $y = \overline{v}$ *and leasing to consumers who receive signal* $y = \underline{v}$ *and a future lease renewal price* $q = \overline{v}$ *if* $0 < c_l < x_4$*.*

When $\psi_{HL} < r < \beta$*, the monopolist's optimal strategy is: 1) Selling only to the consumers who receive signal* $q = \overline{v}$ *if* $\lambda < c_l < c_s$*; 2) Leasing only to the consumers who receive signal* $y = \overline{v}$ *and a future lease renewal price* $q = \overline{v}$ *if* $\min\{\lambda, x_2\} < c_l < \lambda$*; 3) Leasing to all new consumers in each period and a future lease renewal price* $q = \overline{v}$ *if* $0 < c_l < \min\{\lambda, x_2\}$*.*

Therefore, if the reduction in implementation cost in the on-demand model is not large, selling only to the high-end market is still the monopolist's optimal strategy. When this reduction is significant (or c_l is small), and the high and low type consumers' valuations are very different (or r is small), it is optimal for the monopolist to segment the market: sell to the high-end consumers and lease to the low-end consumers using the on-demand model. In the latter case, the monopolist subsidizes the consumers' implementation and learning of their true types at age 1, and recoup his profit later on. In the rest of the cases, the monopolist will totally switch to the new subscription-based or on-demand model.

4 Discussion and Future Research

I have focused on the steady-state solutions in which the seller charges one set of selling and leasing prices that does not change over time. The results can be interpretated as illustrating the market equilibrium in the long run before and after the change in implementation cost in the subscription-based pricing model. Nevertheless, a more complete solution involves modeling the monopolist's optimal pricing strategy while allowing him to choose different prices over time. I will focus on the sub-game perfect equilibria of the dynamic game, where the actions in each period only depend on the payoff relevant state variables, or the Markovian strategies. This analysis will strengthen the existing results in two ways: first, to characterize the conditions under which it is optimal for the monopolist and the consumers to stay in a steady state; second, to show the market transition path with the introduction of the on-demand model.

The theory suggests that the consumers who adopt the subscription approach tend to value the software differently than the consumers who buy the software. I plan to empirically examine this implication using data from Forrester Research. The empirical analysis also aims to identify the other dimensions of firm heterogeneity that also influence their choices between buying the software and adopting the on-demand approach. The results will have direct implications for both IT software and hardware vendors' product strategies.

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