Time Inconsistency of Consumers and Excessive Upgrades in the Software Market

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1   The Problem and Related Literature

It is a common observation in the market for upgrades that firms tend to offer small and immature upgrades very frequently instead of significant upgrades less frequently. Evidence of this might be found in software, computer, and personal electronics. For example, people commonly complain about rush and immature upgrades of consumer-oriented word-processing software. Consumers believe that the sellers offer upgrades which are not tested enough and which do not have significant new features. In this paper the question we are going to address is why the monopolist offers the immature frequent upgrades instead of significant and less frequent ones. As an explanation, we suggest that if the consumers are time inconsistent in the sense of Phelps and Pollak (1968) and Laibson (1997), the monopolist will offer smaller and more frequent upgrades than if the consumers are time consistent.

In the problem, we consider an exponential discounter monopolist who offers upgrades for his product with a certain frequency. The monopolist offers three equal payment plan for three subsequent periods to the consumer who buys the upgrade and charges interest for the late payments. He decides on how frequently he will offer the upgrades and what will be the optimal interest rate in the case where interest rate is endogenous. There is a time inconsistent consumer who wants to maximize his lifetime utility by deciding whether to buy the upgrades and later whether to delay his payments. The problem with the consumer is that he might change his optimal plan of payment at each period since he is time inconsistent. In order to illustrate the effect of consumer time inconsistency, we chose the simplest model with one consumer and a fixed payment plan. We analyzed the problem of monopolist when the interest rate is endogenous as well as it is exogenous, and for each of these cases we divided the problem into two according to whether the consumer is a naive hyperbolic discounter or a sophisticated hyperbolic discounter.

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In our model we assumed that the upgrades build upon each other as in Fishman and Rob (2000) and this is an appropriate assumption for the software products. We assumed that the monopolist offers three equal payment plan since we have to have at least three periods of payment in order to see the time inconsistency of the consumer in his decisions. More than three periods would not change our result.

The main result we obtain in our model is that if the monopolist does not discount the future a lot, then for some fixed cost values, the monopolist offers the upgrades to the more hyperbolic consumers more frequently than the less hyperbolic consumers. This result holds for both naive and sophisticated hyperbolic consumers with changes in cutoff hyperbolic discount factors and in fixed costs. The other important result we got is that there are some cases in which the monopolist offers upgrades more frequently to the naive hyperbolic consumer than to the sophisticated hyperbolic consumer even if they have the same discount factors.

There are papers about product upgrades for durable goods in the literature. Fudenberg and Tirole (1998) analyzed the monopoly pricing of overlapping generations of a durable good. Ellison and Fudenberg (2000) and Fishman and Rob (2000) compared the frequency of product innovations with the social optimum. In this paper, our aim is to explain a common observation: frequent and small upgrades. While others have explained this phenomenon as due to network effects and commitment problems, we demonstrate using the simplest possible model that time inconsistency of consumers also provides an explanation. Since we are using the simplest model to explain the observed phenomenon, we do not attempt to accomplish a technical advancement. There are papers in the literature in study of durable good upgrades or in the study of time inconsistency, but there is no previous study about durable goods upgrades of a monopolist facing hyperbolic consumers.

2   The Model

Our model is based on that of Fishman and Rob (2000). We have a monopolist who offers durable upgrades for his product with a certain frequency to the consumer who already had that product in hand. In addition to the variable cost of creating upgrades, the monopolist also incurs a fixed cost every time he offers an upgrade.The monopolist discounts the future exponentially at the rate of δ and sells his upgrades to the consumer at price p by offering a payment plan of three equal payments, and he charges interest for the late payments. There is one consumer, with $\beta - \delta$ discount factor, who wants to maximize his lifetime utility by deciding whether to buy the upgrade, and after buying whether to pay his payments on time. If the consumer decides to buy a certain amount of upgrade today, we say that he will buy the same amount of upgrade every time it is offered since our problem is stationary.

3   Conclusion and Discussion

In our model, we assumed the monopolist divides the total price of the upgrade into three equal payments as three periods is minimal to see time inconsistent behavior of hyperbolic agents. For more than three periods, we would get the same results but with more complicated calculations. So, for the sake of simplicity we assumed the monopolist divides the payments into three equal ones.

There might be a question about the optimal number of payments that the monopolist offers. If the interest rate is endogenous and the consumer is a naive hyperbolic discounter, the monopolist would prefer to offer as largest as possible number of payments (maybe infinite) to the consumer and use him as a money pump if the consumer does not have budget constraint. If the monopolist's exponential discount factor is less than the exponential discount part of consumer's discount factor, we cannot expect the monopolist to offer an infinite number of payments. As the consumer delays the payment the amount the monopolist will get will be discounted more severely.As a result, we can say that as the discount factor of the monopolist decreases, the optimal number of payments he offers decreases.

If the interest rate is endogenous and the consumer is a sophisticated hyperbolic discounter, the number of periods of payment does not change the monopolist's profit, as long as it is more than one. This is quite intuitive. Since the consumer is sophisticated hyperbolic, the monopolist cannot use him as a money pump and get more profit by making him delay more.

The possible empirical study for our model might be comparing the frequency of upgrades in consumer oriented softwares and business oriented softwares. Since individual consumers are more likely to be time inconsistent than businesses, we expect to see more upgrades in consumer oriented softwares.