Research Report

Do Firms Benefit from High Discount Rates of Customers who Purchase Complementary Products?

DESPITE AMPLE EVIDENCE THAT CUSTOMERS EXHIBIT HIGHER DISCOUNT RATES THAN FIRMS, IT IS NOT CLEAR HOW DIFFERENCES IN DISCOUNT RATES AFFECT OPTIMAL PRICES, PROFITS, AND WELFARE OF COMPLEMENTARY PRODUCTS (WHICH COULD BE GOODS OR SERVICES). WE SHOW FOR COMPLEMENTARY PROUCTS THAT HIGHER DISCOUNT RATES OF CUSTOMERS DO NOT INCREASE PROFIT OR CONSUMER SURPLUS. FIRMS, INCLUDING BANKS, WOULD BE ADVISED TO SEEK TO REDUCE EXCESSIVE DISCOUNT RATES AMONG CONSUMERS.

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Introduction

Recent behavioral research in economics argues that customers discount future benefits at much higher rates than firms. Annual discount rates for 3-year delays, for example, lie in the range of 36%–46% and for 1-year delays within a range of 83%–100% (Frederick et al., 2002). By contrast, a firm's weighted average cost of capital, a good indicator for a firm's discount rate (i.e., 1 divided by the sum of 1 and the discount rate), in most years is between 10% and 11% (Schaaf and Skiera, 2014). Yet, despite ample evidence that customers discount at higher rates than firms, the effect of such time preferences on pricing, profit, and welfare has not sufficiently been studied.

Studying this topic, however, is important because such high discount rates influence consumers' choices when expenditures or benefits occur at least partly in the future. Put differently, high discount rates indicate that consumers have a strong incentive to spend money today at the expense of not being able to spend money in the future. As a result, they might, among other shortcomings, not save enough money for their retirement. This tendency might become even worse if firms also have an incentive to even further encourage con-

sumers to act according to their high discount rates and enjoy today's living at the expense of paying for it in the future.

We study the effect of time preferences on pricing, profit, and welfare in the context of complementary products. We define complementary products as a combination of a durable and a consumable product where neither can be used independently of the other. Complementary product strategies are widespread in consumer goods markets. They include tied products where the consumable can only be used with the same firm's durable, such as Gillette razor blades – in which the razor is durable and blade is consumable; Nespresso coffee machines, where the coffee machine is durable and coffee capsules are consumables; or Sony games consoles, where the console is durable and the game is consumable. But they also include open (or "untied") systems where the consumer is free to use a competitor's consumable with the firm's durable, such as the iPad and audio/video files that can be purchased at both the iTunes store or elsewhere, printers and cartridges, digital wallets and payments that can be made with a variety of banks or credit cards.

The effect of high customer discount rates on profit from complementary services is difficult to predict. First, ignoring discount rates can result in suboptimal pricing decisions (Yao et al., 2012). Second, if customers discount later payments at greater rates than firms, firms may increase the consumable price and decrease the durable price as the latter is charged earlier than the former. The result may be an increase in profit beyond the profit they would obtain if firms and customers had the same time preferences. As a result, the question of whether firms benefit from high customer discount rates is difficult to answer.

Basic Setup of our Model

We analytically model the effect of customers' and firms' discount rates on optimal prices of tie-in complementary services, profits, consumer surplus and thus, welfare. Tie-in complementary products are those products for whom the consumable is sold by the same firm as the durable. We assume that customers have heterogeneous demand functions and explicitly model the two-period nature of the decision process in which the durable is purchased in the first period and the consumable in the second period.

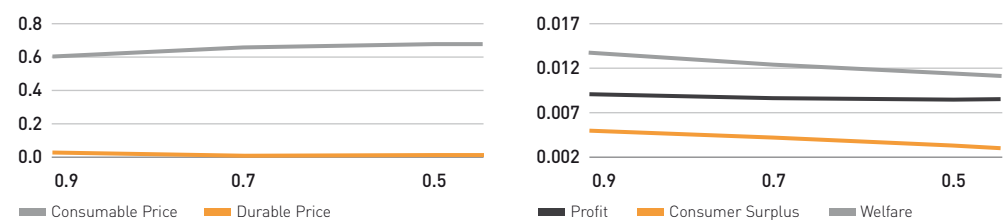**Discout Rates of Consumers** (Measured by Their Discount Factor)

Figure 1: Effect of Higher Discount Rates of Customers on Prices, Profit, Customer Surplus, and Welfare (CS I). (Discount Factor=1/(1+Discount Rate); Durable Marginal Cost=0; Consumable Marginal Cost=0.5; Firm's Discount Factor=0.9)

We also assume that customers have perfect knowledge of prices and product quality and that the firm commits to future consumable prices. When they purchase the durable, customers evaluate the payment for the durable and the discounted value of payments and benefits of the consumable. We specify four competitive settings (CS) depending on whether the firm is a monopolist or is competing in the durable market and on whether complementary products are tied or untied. We derive optimal prices, profit, customer surplus and thus, welfare, in each of the four competitive settings but focus here on the two settings (CS I and CS II) in which the firm tie-in complementary products.

Summary of Findings
Our analysis yields several key insights. First, higher discount rates lead to lower durable prices but higher consumable prices. Because consumers with high discount rates prefer to have lower prices today even if they come with higher prices tomorrow. Second, higher customer discount rates never increase profits and also do not increase customer surplus. Thus, high discount rates hurt both customers and firms.

We simulate the effect of an increase in customer discount rates on prices, profit, and consumer surplus for the competitive setting in which the firm is a monopolist in the durable market and offers a tied complementary product (labeled as CS I) and present the results in Figure 1. As Figure 1 outlines, a higher customer discount rate leads to a higher consumable price and a lower durable price. Figure 1 also illustrates how higher customer discount rates reduce profit and consumer surplus.

Intuitively, customers discount the payments for the consumable but not the payments for the durable. The firm then decreases the durable price and raises the consumable price. This strategy is optimal as long as the firm's discount rate is lower than the customer's discount rate. Yet a lower price for the durable at the expense of a higher price of the consumable will never fully compensate for the loss in customer surplus. Hence, since higher discount rates mean that customers value future benefits less, firms do not benefit from higher customer time preferences. However, since the firm can tradeoff between payments for the durable and for the consumable, the relative decrease of firm profits is less

pronounced than the effect on consumer surplus. Figure 2 illustrates the effect of an increase in customer discount rates for the setting in which the firm competes in durable market and again offers a tied complementary product (labeled as CS II). Again, a higher customer discount rate (here reflected in a lower discount factor) leads to a higher consumable price and a lower durable price. Interestingly, the durable price is even slightly negative, so that firms are selling the durable to customers at a loss. There exist many real world examples, in tie-in complementary services or product, in which firms sell durables at a loss. Similar to CS I, high discount rates decrease customer surplus and welfare as the competition in the durable market yield profits that are always zero. Still, customers do not benefit either from their high discount rates.

Conclusion
Our study shows that neither customers nor firms benefit from higher customer discount rates. Higher customer discount rates relative to the firm's increase consumable prices and decrease durable prices, consumer surplus, and welfare. This result can be observed for many customer product markets in which manufacturers tie durables to consumables, including the Gillette, Nespresso, and Sony examples discussed above. This result outlines that financial service institutions should follow strategies to decrease customers' relatively higher discount rate for complementary products (e.g., credit cards, or financial advice on cash management).

Our results also illustrate that customer discount rates can have a significant impact on firm's prof-

its and consumer surplus. As such, they suggest that the consideration of customer time preferences should play a more prominent role in firms' decisions.

Most importantly, however, our results indicate that for complementary products, neither customers nor firms benefit from higher customer time preference. Thus, our finding illustrates that firms would benefit from lowering customer discount rates. Firms and banks may, for example, invest into educating customers to make them more aware of the effects of very high time preferences or run marketing campaigns that make future expenditures for consumables more salient.

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Discout Rates of Consumers (Measured by Their Discount Factor)

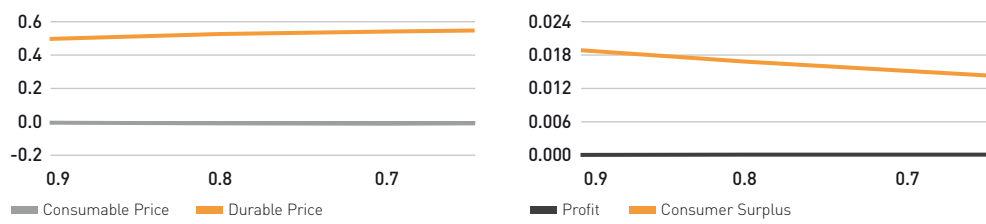Consumable Price   Durable Price   Profit   Consumer Surplus

Figure 2: Effect of Higher Discount Rates of Customers on Prices, Profit, and Customer Surplus (CS II). (Discount Factor=1/(1+Discount Rate); Durable Marginal Cost=0; Consumable Marginal Cost =0.5; Firm's Discount Factor=0.9)