Firm Behavior under Consumer Loss Aversion

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This survey aims to provide an overview of recent developments in the industrial organization literature that explores the behavior of profit-maximizing firms facing consumers with reference-dependent preferences and loss aversion. We discuss the implications of loss aversion on the practice of price discrimination, product differentiation, and incentive provision, among others. A common theme is emerging from these studies: consumer loss aversion may serve to limit the benefits from complex firm strategies that depend on the realizations of uncertainty.

Keywords: Survey, Reference-dependent preferences, Loss aversion, Personal equilibrium, Monopoly pricing, Price discrimination, Product differentiation, Agency problem

JEL Classification: D03, D21, D42, D43, L12, L13, M52

I. Introduction

Since the seminal contribution of Kahneman and Tversky (1979), a large literature has emerged to document the importance of reference-dependent preferences and loss aversion in economics. Evidence suggest that loss aversion can account for diverse economic phenomena, ranging from the equity premium puzzle (Benartzi and Thaler 1995) to the seller

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[**Seoul Journal of Economics** 2014, Vol. 27, No. 2]

behavior in a housing market (Genesove and Mayer 2001).[1] In this survey, we provide an overview of recent developments in the industrial organization (IO) literature, which analyze the behavior of firms that serve loss-averse consumers. We discuss the implications of consumer loss aversion on the practice of price discrimination, product differentiation, and incentive provision, among others.

The well-documented phenomenon known as the "endowment effect" illustrates reference-dependence preferences. Many experimental and survey studies have shown that the willingness to pay (WTP) of individuals is usually lower than their willingness to accept (WTA) for the same object (*e.g.*, Thaler 1980; Kahneman, Knetsch, and Thaler 1990). This contrasts with the predictions of the standard economic theory, which states that the two values should be equal. However, reference-dependent preferences with asymmetric impact of losses are consistent with the divergence between WTP and WTA: paying for a good that one does not own incurs money loss and hence reduces WTP, whereas giving up a good that one already owns leads to a physical loss and hence increases WTA. A utility function that captures this wedge between WTP and WTA adds to the standard "intrinsic utility" term a new "gain-loss utility" term with respect to a reference point together with a loss aversion parameter greater than one.

Despite the strong evidence in support of reference-dependent preferences, critics of this theory have pointed out the *ad hoc* treatment of the determination of the reference point. They question whether the freedom to choose the exact specification of reference point (*e.g.*, the status quo, current wealth level) has been the driving force behind the substantial explanatory power the theory has gained. In recent years, however, a new breed of theoretical and empirical explorations of reference-dependence preferences has emerged to offer some discipline and helped advance the literature in a coherent manner.

A growing number of empirical studies have highlighted the specific role played by *expectations* in the formation of reference points. By directly manipulating the expectations of laboratory subjects, Abeler, Falk, Götte, and Huffman (2011) and Ericson and Fuster (2011) showed that the expectation on a random event influences how subjects behave *after* the uncertainty is resolved. In a lab experiment, Gill and Prowse (2012) found that expected monetary payoffs affect subjects' effort provision in a competitive environment. Through field studies, researchers

[1] See Camerer (2006) for a survey.

have found evidence of the significant roles played by expectations as references in various areas including professional golf games, taxi drivers' labor supply, police officers' performance, and domestic violence (*e.g.*, Pope and Schweitzer 2011; Crawford and Meng 2011; Mas 2006; Card and Dahl 2011). By contrast, a series of papers by Kőszegi and Rabin (2006, 2007, 2009) proposed a *rational* expectations approach in which the reference point is taken to be a stochastic distribution of actions/outcomes.[2]

The results from various models of firm behavior that adopt the expectations approach to the reference-dependence preferences are presented in this survey. While this unified approach allows us to offer an organized overview of how consumer loss aversion affects profit-maximizing firms, it is also important to note that many firm settings are indeed natural grounds for expectations to come into play. Uncertainty is a key ingredient of these situations. For example, when a firm offers a menu of products to discriminate certain types of consumers, the consumer may not yet know the full extent of his or her utility function. Similarly, an incentive scheme designed to tackle a moral hazard problem is usually presented to a worker prior to the realization of uncertain outcomes. In these situations, it is plausible to think that the agent evaluates the choices offered by the firm with respect to his or her expectations about the uncertain future in some way.

A common theme is emerging from this new literature within IO. Economic theories based on standard consumer preferences often prescribe firm strategies that are rather complex and specify substantial variations in outcomes to deal with different realizations of uncertainty. A monopolist can improve profit by offering multiple product qualities and prices to screen consumers with heterogeneous demands. Comparably, a financial intermediary can encourage greater efforts from its borrowers by designing a sophisticated payment scheme that depends on outcome realizations. The main implication of consumer loss aversion is the limitation imposed on the benefits from such complex practices when consumers admit reference-dependent preferences and loss aversion.

In Section II, we introduce recent studies on price discrimination with consumer loss aversion. This section is organized around a summary of

[2] Another branch of expectation-based reference-dependent preferences was previously proposed by Bell (1985), Loomes and Sugden (1986), Gul (1991), and Shalev (2000). These models consider a fixed expectation as reference point. See Sprenger (2011) for an experimental effort to distinguish between the two approaches.

a recent paper by Hahn, Kim, Kim, and Lee (2014), which we borrow to formally present how the decision model of Kőszegi and Rabin is applied to a firm setting. We also offer the main intuitions behind the mechanism of loss aversion that are applied broadly to other models of price discrimination and beyond. In Section III, we turn to other firm settings in which the effects of consumer loss aversion have been explored. Loss aversion has been applied to other monopoly pricing models (without the issue of screening), competition models with differentiated products, and agency models with moral hazard, among others.

This survey is by no means exhaustive. In order to focus on the issues related to optimal firm strategies against loss-averse consumers, we had to leave out many interesting and relevant topics in which loss aversion has been shown to generate meaningful new insights. Moreover, the IO literature on loss-averse consumers is awaiting answers to a host of outstanding questions (*e.g.*, Ellison 2006). There are also other "behavioral" approaches that can address well-known economic questions, including the ones introduced in this survey. We refer interested readers to Spiegler (2011) and Kőszegi (2013) for a treatment of broader sets of issues and models in this burgeoning area of research. Finally, the insights from these behavioral approaches are by no means meant to be direct substitutes for existing economic theories based on the rational agent paradigm. Rather, our understanding of the complex world may well be best advanced by taking a more balanced and complementary interpretation of all the findings.

II. Price Discrimination

When a firm faces consumers with heterogeneous levels of willingness to pay, it can increase profit by offering multiple product types and screening the consumers. However, recent papers have established that the effectiveness of the practice of price discrimination is limited when the consumers admit reference-dependent preferences and loss aversion. The basic intuition is as follows. In the process of screening consumers with reference-dependent preferences, some types of consumers would purchase bundles that diverge from their reference point and as a result, they experience an additional utility loss. Subsequently, such consumers would find extra incentives to deviate from the bundles designed to screen them, thereby tightening the incentive compatibility constraints that the profit-maximizing firm needs to satisfy.

As discussed in the Introduction, an important issue is how the consumer's reference point is formulated. In a recent paper, Hahn, Kim, Kim, and Lee (2014), henceforth referred to as HKKL, transformed the expectation-based reference point model of Kőszegi and Rabin (2006), henceforth referred to as KR, into a standard screening model. Incorporated into the model are vertically differentiated demands for quality based on Mussa and Rosen (1978). In this section, we employ the analysis of HKKL to formally describe the KR model of reference-dependent preferences and introduce the main intuitions behind the process of consumer loss aversion that can be broadly applied to other models of firm behavior.

A. The Model of Hahn, Kim, Kim, and Lee (2014)

Consider a monopoly facing a consumer with two possible types of willingness to pay, $\theta \in \{\theta_L, \theta_H\}$, for its product of quality q. The monopolist's constant marginal cost of production is $c > 0$. The low willingness-to-pay type is commonly known to occur with probability p.[3]

The consumer's utility function, given a "bundle" $b = (q, t)$ (where t denotes transfer), consists of the sum of two parts.

First, the usual quasi-linear "intrinsic utility" is given by

$$m(b; \theta) = \theta \, v(q) - t,$$

where $v(\cdot)$ satisfies the standard technical conditions.

Second, the consumer experiences a "gain-loss utility" with respect to his or her *ex ante* expected consumption plan in each possible realization of uncertainty θ. Formally, let $r_i = (q_i^r, t_i^r)$ denote the bundle that the consumer expects to purchase if his or her type turns out to be θ_i, $i = H, L$. Given a collection of such expected consumption plans, that is, reference point $R = \{r_L, r_H\}$, type-θ buyer's gain-loss utility from $b = (q, t)$ is given by

$$\begin{aligned} n(b; \theta, R) = p[\mu(\theta v(q) - \theta_L v(q_L^r)) + \mu(t_L^r - t)] \\ + (1-p)[\mu(\theta v(q) - \theta_H v(q_H^r)) + \mu(t_H^r - t)], \end{aligned}$$

where μ is an indicator function such that, for any $k_1, k_2 \in \mathbb{R}_+$,

[3] HKKL goes beyond the binary demand type case and also analyzes the case of a continuum of types.

$$\mu(k_1 - k_2) = \begin{cases} k_1 - k_2 & \text{if } k_1 \geq k_2 \\ \lambda(k_1 - k_2),\ \lambda > 1 & \text{if } k_1 < k_2. \end{cases}$$

To clarify this formulation, consider for example the term $\mu(\theta v(q) - \theta_L v(q_L^r))$ in the RHS. This term represents type-θ's gain-loss from consuming quality q relative to q_L^r, the quality level that he or she *would* have enjoyed under the realization θ_L; it is then weighted by the corresponding prior probability p. The parameter λ measures the degree of loss aversion; $\lambda > 1$ means that the buyer is *loss averse*, that is, from a given difference from the reference point, the buyer feels an asymmetrically larger loss than gain.

Given the reference point R (expected choices of bundles), a type-θ buyer's overall utility from $b=(q, t)$ is then given by

$$u(b|\theta, R) = m(b; \theta) + n(b; \theta, R). \tag{1}$$

The relative importance of gain-loss utility can also be adjusted by multiplying the latter term in the LHS by some parameter. However, it would be inappropriate to assume a value that is too large. Moreover, following Tversky and Kahneman (1991) and Kőszegi and Rabin (2006), the gain-loss utility is additively separable across the two consumption dimensions, namely, quality and monetary transfer.

The situation depicted by this model can be summarized as follows. The monopolist commits to a menu of bundles, to be referred to as M, before the realization of uncertainty. The consumer observes the menu and forms a reference point, which amounts to his or her expected contingent actions. Once the consumer's type is realized, he or she chooses a bundle. It is also possible that the consumer does not make a purchase at all, in which case the reservation utility is zero. The final utility is given by Equation (1).

B. Personal Equilibrium

KR requires that the consumer's reference point consumption plan be consistent with his or her actual choices; that is, the expectation should be *rational*. We now introduce the notion of *personal equilibrium* proposed by KR in the setup of HKKL. Let ϕ denote the zero-zero bundle to represent non-participation.

Definition 1. *Given any menu M, $R=\{r_i\}_{i=H,L} \subseteq M \cup \{\phi\}$ is a personal*

equilibrium (PE) if

$$u(r_i \mid \theta_i, R) \geq u(b \mid \theta_i, R), \quad \forall b \in M \cup \{\phi\}, \forall i = H, L. \tag{2}$$

Furthermore, $R = \{r_i\}_{i=L,H}$ is a truthful personal equilibrium (TPE) if it is a PE given $M = R$.

It is straightforward to apply the revelation principle here: any PE can be equivalently represented by a TPE. In the case of a TPE, the reference point itself is offered as a menu and therefore, each type only needs to prefer its choice of bundle over the other type's bundle or the null bundle. Then, the requirements of PE in (2) can be interpreted as the following incentive compatibility (IC) and (ex post) individual rationality (IR) constraints:

$$u(r_i \mid \theta_i, R) \geq u(r_{-i} \mid \theta_i, R) \tag{IC}$$
$$u(r_i \mid \theta_i, R) \geq u(\phi \mid \theta_i, R). \tag{IR}$$

There are several things to note in the above definition. First, this adaptation of KR assumes that, although *a priori* the reference bundles may come from anywhere (*e.g.*, a product offered by another competing firm), the consumer's reference point is essentially generated within the given menu.[4] Second, the monopolist commits to a menu ex ante, and no further introduction of products is made after, which can additionally influence the consumer's expectation. Third, there may in fact be multiple personal equilibria in a given menu. KR also proposes a refinement of PE: a *preferred personal equilibrium* (PPE) is the PE that yields the highest ex ante expected utility to the consumer.[5]

C. Optimal Menu under Consumer Loss Aversion

The optimal menu in the above model with standard preferences entails price discrimination to screen the consumer with high willingness to pay. HKKL demonstrate that with reference-dependent preferences and loss aversion, additional costs of screening surface and the standard practice of price discrimination become dominated by other contractual

[4] A related concept of contextual reference prices has been put forward in the marketing literature. See Mazumdar, Raj, and Sinha (2005) for a review.

[5] The analysis of HKKL considers both PE and PPE as solution concept. It turns out that the qualitative results are similar under both concepts.

forms if the consumer is sufficiently loss averse.

Consumer loss aversion creates two new forces at work. First, when the consumer purchases a bundle ex post, he or she compares the resulting utility with the utility that would result from opting out. The gain-loss utility of this comparison results in the consumer experiencing a loss on quality and a gain in money. Therefore, faced with a loss-averse consumer, the monopolist can squeeze more profit out of the type whose participation constraint is binding by offering a higher quality product. Similar to the case of the standard screening problem, it is the consumer with low demand for quality to whom this participation effect applies.

Second, for the consumer who acquires an information rent (*i.e.*, the high willingness-to-pay type), deviation to a lower quality-price bundle generates a complex gain-loss comparison effect in terms of quality and money. In particular, the gain-loss comparison in this case is weighted by the likelihood that the event does *not* happen. The high-demand consumer would have purchased the cheaper bundle, had his or her demand turned out to be a less quality-sensitive type. If the chance that this event occurs increases, the impact of the gain-loss utility under KR's expectation approach likewise increases.

These two effects indeed reinforce each other to limit the benefits of price discrimination. On the one hand, the monopolist finds an additional incentive to offer a higher quality and more expensive bundle to the low-demand type consumer. On the other, the monopolist faces a more challenging task to provide incentives for the high-demand type consumer to separate himself or herself. The overall consequence is that when the likelihood of low willingness-to-pay consumer is sufficiently large and the degree of loss aversion lies in an intermediate range, the optimal strategy of the monopolist is actually to offer a single product to accommodate both types of the consumer. With an excessively loss-averse consumer, profit maximization is achieved by a *reverse-screening* menu in which the low type is given a higher quality, more expensive product.[6]

The results of HKKL (and other related papers discussed below) provide a useful new perspective on real life practices of price discrimination. While a plausible account of coarse screening exists in the form of fixed product costs (*e.g.*, Dixit and Stiglitz 1977; Spence 1980), there are

[6] This latter observation, however, is not robust in the model with continuous types and also requires a degree of loss aversion that may well be too high. Camerer (2006) summarizes various estimates on the loss aversion parameter.

many instances where such frictions are not significant and yet the firms' product offerings only contain minimal variations. For example, different seats in existing entertainment venues are associated with different views and setting multiple seating categories incurs essentially zero cost. Nonetheless, firms in these industries often choose limited seating categories, or even opt for single ticket pricing. See the survey by Courty (2000) as well as other related references in HKKL.

There are other related works of price discrimination with loss-averse consumers in which the intuitions sketched above apply to generate firm strategies that are simpler than those employed under standard preferences.

Similar to the work of HKKL, the study of Herweg and Mierendorff (2013) examined a monopolist facing a loss-averse consumer. They formulated the consumer in the framework of KR (with the gain-loss utility occurring only in the money dimension and not in the quality dimension), but considered an alternative timeline in which the consumer commits to a contract ex ante. For instance, a holiday maker who rents a car does not know exactly how much he or she is going to use the car at the time of rental. Restricting attention to two-part tariffs, the authors showed that the monopolist may in fact want to set flat tariffs to maximize profits.

Another model of price discrimination with loss-averse consumers was considered by Carbajal and Ely (2013). In contrast to the model of HKKL, the seller in this model offers a menu to a consumer, who already knows his or her type and admits any arbitrary contingent consumption plan as a reference point. This approach, among others, allowed the authors to demonstrate how the form of the optimal menu depends on the shape of the reference point itself. Similar to HKKL however, loss aversion in this model creates an additional downward distortion in the optimal quality levels of high consumer types.

III. Pricing, Competition, and Incentives

A. Pricing

Price stickiness is one of the most widely noted phenomena in macroeconomics. The leading theory explains the phenomenon as a situation where non-trivial fixed costs (also called "menu cost") prevent firms from continuously changing prices. Models incorporating consumer loss aversion propose an alternative possibility: loss-averse consumers are first-order averse to risks and therefore, fluctuations in price reduce con-

sumers' welfare, which in turn lower consumers' willingness to buy the product. Thus, profit-maximizing firms have incentives to charge stable prices, even when production costs are fluctuating.

Heidhues and Kőszegi (2005) considered a monopolist faced with loss-averse consumers and uncertain cost of production, and showed that it is optimal for the monopolist to assign one price for the different realizations of production cost. More specifically, even when the probability distribution of the cost is continuous, the optimal distribution of prices is discrete under certain assumptions. This result is due to the monopolist's effort to reduce consumers' sense of loss that comes from the comparison between the price they pay and the one they would have paid. By reformulating the main ideas of Heidhues and Kőszegi (2005) and Kőszegi and Rabin (2006), Spiegler (2012) managed to provide a simplified model (a "cover version"), which generates qualitatively identical results. In addition to price rigidity, he showed a couple of new effects of loss aversion on monopolist's price. In particular, his model predicts that the average price is lower under loss aversion because consumers' willingness to pay is lower on average. He also showed that the price is more likely to be sticky when the uncertainty is on the demand side instead of on the production cost.

Eliaz and Spiegler (2013) incorporated the idea of sticky price due to reference dependent utility into a dynamic model to explain wage stickiness and excessive volatility of the unemployment rate, which have been the subject of lively debate among macroeconomists (*e.g.*, Shimer 2005). Eliaz and Spiegler (2013) showed that the introduction of reference dependence in workers' utilities to a game-theoretic search and matching model creates endogenous downward rigidity in wage and increases the volatility of the unemployment rate. In particular, they assumed that an individual worker's output declines when his wage stochastically drops from its normal level (*i.e.*, reference point) which is given as the lagged expectation. In each period, firms face productivity shocks and make one-period non-contingent take-it-or-leave-it offers. It was shown that the wage is rigid within a match, but flexible for new matches, which is qualitatively consistent with empirically observed patterns.

B. Competition

The papers introduced above considered either a monopoly seller or a search market, which generates bilateral monopolies. The next step is to investigate how loss aversion affects the behavior of firms under

competition.

Heidhues and Kőszegi (2008) incorporated loss aversion to the otherwise standard circular city model to demonstrate that under certain conditions, competitors who have asymmetric production costs may charge a symmetric price, labeled as "focal price." A key feature of the model is the initial lack of ideas of consumers with regard to which product they will like the most and as such, the consumers formulate a contingent plan, which serves as the reference in latter stages of the game. A consumer ends up comparing the purchase made with all the other deals that he or she would have made. If a firm charges a price higher than those of its rivals, a decrease in demand would be disproportionately large because consumers feel an additional sense of loss in the money dimension, whereas an increase in demand due to a price cut would be relatively small. Heidhues and Kőszegi (2008) showed that whenever consumers are sufficiently loss averse, a focal equilibrium exists in which all firms set the same price in spite of the differences in production cost.

Building upon Heidhues and Kőszegi (2008), Karle and Peitz (2014) examined the effect of consumer loss aversion on the intensity of competition between horizontally differentiated firms. In particular, they assumed that some consumers have perfect information about their ideal products and so experience neither gain nor loss when buying a product, whereas the others are not aware of their best matches and hence admit gain-loss utilities depending on the realization of the "match value." It was shown that when firms are symmetric in terms of production efficiency, the equilibrium profit monotonically decreases in the share of informed consumers. This observation implies that consumer loss aversion relaxes price competition. In asymmetric duopoly, however, the overall effect on price competition depends on the size of the difference in the production cost. When the cost difference is sufficiently large, the markups for both firms are lower in the presence of consumer loss aversion than in its absence. This ambiguity comes from the fact that consumers can experience gain and loss at the same time in the different dimensions. The loss aversion in price dimension plays a pro-competitive role, whereas that in product dimension plays an anti-competitive role. Thus, when the asymmetry in the market share is expected to be sufficiently large, the pro-competitive effect of loss aversion in price dimension dominates that in product dimension, resulting in lower markups in equilibrium. Analyzing a model with exogenous reference point, Zhou (2011) also showed that loss aversion in price dimension

intensifies competition, whereas loss aversion in product dimension softens competition.

C. Incentive Provision

Another area of firm decision making concerns the problem of providing incentives for its employees whose actions are private information. In contrast to adverse selection settings in which complete removal of differentiation is often optimal, a contract that is completely unresponsive to the realizations of uncertainty could not solve the moral hazard problem even with a loss-averse agent. In such situations, firms would offer a contract that responds to the performance of its employees less finely than the optimal contract without worker loss aversion.

De Meza and Webb (2007) and Herweg, Müller, and Weinschenk (2010) characterized the optimal wage contract for loss-averse workers. Because variations in payment reduce the expected value of the contract and generate a loss when the realized wage falls short of the reference wage, the firm has to provide a high baseline wage to implement a strong incentive scheme. Herweg, Müller, and Weinschenk (2010) showed that if the worker's reference point is created by his rational expectation, the optimal contract has only two possible wage levels ("bonus structure") under certain conditions. By contrast, De Meza and Webb (2007) considered the case where the reference point is the certainty equivalent of the expectation as in Gul (1991), and showed that the payment is flat for a range near the reference point. If the reference point is the median wage, then the optimal compensation is unresponsive up to the reference point, and increases thereafter ("option-like" compensation scheme). Macera (2012) studied a repeated moral hazard model with the agent's loss aversion. Results showed that in the dynamic setting, the optimal compensation may be completely unresponsive to the performance of the current period.

IV. Conclusion

In this survey, we attempted to introduce recent literature on firm behavior under loss-averse consumers whose utilities depend on their expectations as reference point. In the presence of uncertainty, a profit-maximizing firm in the standard models has incentives to adopt strategies that prescribe different outcomes for different realizations of uncertainty. Consumer loss aversion limits the benefits of such complex behavior.

An important feature of the models discussed in this survey is the presence of exogenous uncertainty. Even in setups without such uncertainty, the expectation-based approach to reference-dependent preferences can deliver interesting new insights. In contrast to the papers that illustrated firms' incentives to provide insurance against stochastic loss, those of Heidhues and Kőszegi (2014) and Rosato (2013) examined whether firms have incentives to introduce uncertainties into deterministic environments to exploit the feeling of loss that would arise from not buying a product. Loss aversion has also been applied to a number of settings beyond the firm context. For instance, Eisenhuth (2010) considered auctions with loss-averse bidders, and Grillo (2013) introduced a loss-averse receiver into a cheap talk game.

The literature on applications of loss-averse agents is still at its early stages, and numerous relevant questions remain. For example, most of the existing models do not consider dynamic interactions between firms and consumers. The effects of consumer loss aversion on the outcomes of dynamic models, such as the profitability of collusion, the design of durable goods, and the incentive provision for innovation, are some of the interesting topics in this direction. The role of worker loss aversion in organizations and labor markets is another potential topic for further investigation. In particular, re-analyzing standard labor market models of career concerns or tournaments could lead to fruitful new insights. Finally, loss aversion of investors is believed to be relevant in financial markets. However, formal analysis of its impact has been limited thus far. How firms should distribute dividends to loss-averse investors and how security issuers can optimally structure financial products are just a few interesting directions for future research in this area.

(Received 16 March 2014; Revised 27 April 2014; Accepted 28 April 2014)

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