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Overconfident Consumers in the Marketplace[†]

Michael D. Grubb

When consumers sign contracts, expectations about future usage of the product or service matter. For instance, the value provided by car insurance depends on how likely a consumer believes she is to file a claim; the value provided by a gym membership depends on how often a consumer anticipates going to the gym; and the value provided by a cellular phone contract depends on how many gigabytes of data a consumer anticipates using. The standard modeling paradigm makes the expedient assumption that consumers have rational expectations. Imposing rational expectations drastically simplifies models and eliminates the need to directly measure beliefs as they coincide with the distribution of observed outcomes. Yet a large literature shows that consumer beliefs often deviate substantially from rational expectations in systematic ways. This has important consequences for contract design, firm profits, consumer welfare, and public policy.

The term overconfidence is used broadly in the psychology literature, referring to both *overoptimism* and *overprecision*. Overoptimistic individuals overestimate their own abilities or prospects, either in absolute terms or in comparison to others. In contrast, overprecise individuals place overly narrow confidence intervals around forecasts, thereby underestimating uncertainty. These biases can lead consumers to misforecast their future product usage, or to overestimate their abilities to navigate contract terms. In consequence, consumer overconfidence causes consumers

■ *Michael D. Grubb is Assistant Professor of Economics, Boston College, Chestnut Hill, Massachusetts. His email address is michael.grubb@bc.edu.*

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to systematically misweight different dimensions of product quality and price. Poor choices based on biased estimates of a product's expected costs or benefits are the result.

For instance, overoptimism about self-control is a leading explanation for why individuals overpay for gym memberships that they underutilize (DellaVigna and Malmendier 2006). Overoptimism leads consumers to overestimate gym attendance and hence to overweight the membership benefit of avoiding per-visit gym fees. Similarly, overprecision is a leading explanation for why individuals systematically choose the wrong calling plans, racking up large overage charges for exceeding usage allowances in the process (Grubb 2009; Grubb and Osborne 2015). Overprecision leads consumers to underestimate the variance of future calling, and hence to underweight the cost of calling plans under both low and high usage.

While overconfidence necessarily leads to suboptimal choices, this paper addresses three additional questions about how consumer overconfidence alters market outcomes. First, what will firms do to exploit consumer overconfidence? Firms in many sectors seek to exploit consumer overconfidence by introducing complicated pricing features—and these pricing features are robust to competition. Second, what are the equilibrium welfare consequences of consumer overconfidence for consumers, firms, and society? Not unexpectedly, the welfare consequences for firms and consumers depend on whether overconfident consumers over- or undervalue the offered contracts, as well as on market structure and the nature of consumer heterogeneity. It turns out that competition may fail to protect overconfident consumers from their own mistakes, and that sophisticated consumers often exacerbate the resulting harm to overconfident consumers. Third, what are the implications of consumer overconfidence for public policy? The analysis suggests that policymakers should try to anticipate firms' equilibrium responses to consumer protection measures. Banning contractual terms that exploit overconfidence need not help consumers if firms respond by raising up-front payments an offsetting amount. Yet the analysis also shows that two important market statistics can help policymakers distinguish markets in which regulation may have limited benefit (for example, cellular services, Grubb and Osborne 2015) from those in which regulation may substantially help overconfident consumers (for example, credit cards, Agarwal, Chomsisengphet, Mahoney, and Stroebel 2015).

Overconfidence is just one of several biases that lead consumers to systematically misweight the various dimensions of product price or quality when computing the expected utility of a purchase. For instance, projection bias leads consumers to overweight current preferences, overvaluing unhealthy snacks when hungry (Loewenstein, O'Donoghue, and Rabin 2003) and winter coats when cold (Conlin, O'Donoghue, and Vogelsang 2007). Similarly, individuals with limited attention underweight nonsalient attributes such as eBay shipping fees (Hossain and Morgan 2006; Einav, Kuchler, Levin, and Sundaresan 2015), commodity taxes not included in posted prices (Chetty, Looney, and Kroft 2009), and hidden add-on fees (Gabaix and Laibson 2006). While I focus on overconfidence, and in particular on two important mistakes made by overconfident consumers—misforecasting

consumption and overestimating ability to navigate contract terms—the lessons in the paper apply more broadly to all such biases. In contrast, behavioral biases that limit search, generate inertia, or confuse choices in a manner uncorrelated across consumers have starkly different market implications that I discuss in Grubb (2015b).

Are Consumers Overconfident?

The evidence for overconfidence—both in the form of overoptimism and overprecision—is rooted in more than half a century of psychology research (Lichtenstein, Fischhoff, and Phillips 1982). While several strands of early work on overoptimism must be partially discounted in light of recent criticism (for instance, by Benoît and Dubra 2011), the overall case for overconfidence remains robust, as described as described in Malmendier and Taylor's introduction to this symposium. Here, I focus more narrowly on evidence that consumer overconfidence is important in the marketplace. Such evidence is particularly important for overoptimism, which is known to be context dependent (Weinstein 1980).

Evidence for consumer overconfidence comes from three sources. First, there are experiments in market-relevant settings. For instance, Silk's (2004) experiments suggest that individuals are overoptimistic about the likelihood of redeeming mail-in rebates. Ericson's (2011) related experiment identifies a plausible reason. His experiment asked students to decide between a small payment that would be received automatically and a larger payment that needed to be claimed in six months. Their choices imply that subjects anticipated claiming the payment in six months' time with an average probability of 76 percent, but only 53 percent actually claimed the payment. Ericson (2011) concludes that individuals are overoptimistic about their *prospective memory*, or their ability to remember to take planned actions.

Second, field data on consumer choices provides evidence of consumer overconfidence. Consumer beliefs can be inferred from contract choices (or elicited by survey) and compared to later usage to identify bias. For example, in a study of a New England health club, DellaVigna and Malmendier (2006) show that users who chose a monthly membership could have saved an average of more than 40 percent by foregoing a membership and paying per-visit. This finding is consistent with overoptimism about gym attendance due to overoptimism about self-control. In a study of consumer responses to credit card offers, Ausubel (1999) finds that "consumers are at least three times as responsive to changes in the introductory interest rate as compared to dollar-equivalent changes in the post-introductory interest rate." This finding is consistent with overoptimism about the likelihood of repaying or refinancing debt in time to avoid paying post-introductory rates, perhaps due to overoptimism about self-control (Shui and Ausubel 2005; Heidhues and Kőszegi 2010). In a study of cellular service demand, my coauthor and I use a structural model to estimate that cellular phone consumers are overprecise; specifically, they

underestimate the noise in their forecasts of their own future demand for calls by 62 percent (Grubb and Osborne 2015).

Third, in addition to direct evidence from consumers' contract choice mistakes, field studies can also provide indirect evidence of consumer overconfidence from firm pricing strategies. For example, in Grubb (2009), I show that given observed heterogeneity in calling patterns, cellular carriers' service pricing can be explained as a response to consumer overprecision but not as optimal price discrimination between unbiased consumers. In a similar vein, Gottleib and Smetters (2014) convincingly argue that the contractual terms of whole life insurance policies can only be profit maximizing if customers underweight the risk of allowing their policies to lapse—consistent with overoptimism about liquidity shocks.

For economists, a common question is "Doesn't overconfidence go away with learning?" On the one hand, learning can mitigate overconfidence with appropriate feedback (Bolger and Önkal-Atay 2004). On the other hand, Gabaix and Laibson (2006) show that competition need not give firms an incentive to educate or de-bias consumers, and lab experiments show that outcome feedback of the sort consumers likely receive in practice is often ineffective (Subbotin 1996). Moreover, field studies of consumer choice confirm that learning is no panacea for avoiding past mistakes. Choices may improve slowly (Grubb and Osborne 2015), lessons may be forgotten (Agarwal, Driscoll, Gabaix, and Laibson 2013), and after peaking in financial sophistication in middle age, individuals succumb to contractual traps at an increasing rate as they grow old (Agarwal, Driscoll, Gabaix, and Laibson 2009).

Firms Complicate Contracts to Exploit Overconfidence

In the standard common-prior framework, firms design contracts with two goals in mind: to create surplus from trade and to extract a share as profit. In other words, firms aim to bake a large pie and keep a large share for themselves. Relaxing the common-prior assumption to allow for consumer overconfidence adds a new consideration. Overconfident consumers may overvalue or undervalue offered contracts relative to the true value they deliver. Firms naturally prefer consumers to overvalue contracts as much as possible, because that allows firms both to charge more for contracts and to sell more contracts. Hence, firms selling to overconfident consumers design contracts with an additional goal in mind: either to maximize the amount by which consumers overvalue contracts or to minimize the amount by which consumers undervalue contracts, depending on the situation. In other words, firms aim to bake a large pie, keep a large share for themselves, and make the piece served to customers appear larger than it is.

To understand the implications of consumer overconfidence for firm pricing practices, I focus on two important ways in which overconfidence may cause consumers to misvalue offered contracts. First, overconfident consumers may misforecast their future usage of services. For instance, an overconfident driver

may undervalue car insurance because he underestimates the likelihood of filing a claim (Sandroni and Squintanti 2007, 2013). When consumers misforecast future usage, firms have an incentive to distort marginal prices and/or product quality to exploit the mistake (for example, DellaVigna and Malmendier 2004; Elaiz and Spiegler 2006, 2008; Grubb 2009; Heidhues and Kőszegi 2010). Second, overconfident consumers may be overoptimistic about their own abilities of self-control, prospective memory, or attention. Such consumers overvalue contracts because they overestimate their abilities to navigate contract terms to take advantage of contract benefits or avoid contract costs. For instance, an overconfident consumer may overestimate the likelihood of remembering to mail in a rebate. Firms have an incentive to complicate their contracts with precisely those terms that consumers overestimate their own abilities to navigate (for example, DellaVigna and Malmendier 2004; Gilpatric 2009; Holman and Zaidi 2010; Grubb 2015a).

When Overconfidence Involves Misforecasting Usage

Let us begin by considering implications for pricing when overconfident consumers misforecast their usage. A consumer who underestimates future usage also underestimates the chance of paying marginal fees, and hence underestimates the cost of any increases in marginal prices. When this occurs, firms have an incentive to inflate marginal prices above marginal cost to increase contract overvaluation or mitigate contract undervaluation.

For example, consider a service contract that specifies an up-front fixed fee plus an additional marginal price charged per unit of the service used. Suppose that an overconfident consumer will use exactly one unit of the service with probability 1, but underestimates his usage, believing that he will only use the unit with probability 1/2. Moreover, suppose for a moment that these probabilities are fixed, independent of marginal price. Consider increasing the marginal price by $2, but lowering the contract fixed fee by $1. This change raises the total cost of the contract by $1. From the consumer's perspective, however, the expected cost remains the same because the consumer underestimates the likelihood of paying the $2 increase in marginal price. Thus, the consumer overvalues the contract by an additional dollar, which translates into an additional dollar of profit for the firm.

Ignoring risk aversion or liquidity constraints, the argument in the preceding example for increasing marginal price by $2 (coupled with a $1 reduction in the fixed fee) could be repeated ad infinitum. This leads to the implausible prediction that the optimal marginal price is infinite. Ruling out such implausible predictions is in fact an important reason that the common-prior assumption is standard in economics. However, a common prior is often superfluous for ruling out infinite bets from consumer contracts. This is because contracts typically specify payments conditional on usage or other consumer behavior that is endogenous (rather than exogenous, as implausibly assumed in the example above).

For instance, suppose that the contract in question is a car lease. If the marginal price per mile were too high, lessors would simply avoid driving their cars and the contracts could not be optimal. Thus, the size of the optimal pricing

distortion is endogenously limited. Alternatively, consider the cartoon character Dogbert's offer of a product for $1,000,029 with a mail-in rebate for $1,000,000 (Adams 2003). While in principal this offer could exploit consumers who typically overestimate the likelihood of remembering to mail in rebates, such a high rebate value is self-defeating if it encourages consumers to adopt effective memory aids. These or related arguments can endogenously limit the terms of all of the exploitative contracts that I discuss below. Hence, for practical purposes we need worry no further about million dollar rebates, infinite marginal prices, and other implausibly large contract terms.

When consumers underestimate usage, the marginal prices specified by a contract serve two roles. First, marginal prices affect consumers' usage decisions and, hence, the surplus created by the sale of a contract. To maximize total surplus, firms would like to set marginal prices equal to marginal cost.[1] Second, marginal prices serve as the stakes of a speculative bet about how much the consumer will use. When the consumer uses more than expected, the firm wins the bet, receiving the marginal payments in compensation. To maximize the contract overvaluation created by this speculative bet, firms would like to set marginal price as high as possible. The optimal marginal price is chosen to balance these two considerations—it is set at the point above marginal cost where the additional gains from exploiting consumers' mistaken usage forecasts are offset by the additional costs from distorting consumers' true usage choices.

When overconfident consumers overestimate rather than underestimate future usage, the logic is similar but reversed: firms have an incentive to discount marginal prices below marginal cost. As consumers overestimate the chance of paying marginal fees, they also overestimate the value of any discount to marginal prices. Hence discounting marginal prices in this context either contributes to contract overvaluation or mitigates contract undervaluation.[2]

Will overconfidence distort marginal prices up or down? The answer depends on whether overconfident consumers under- or overestimate future usage. That depends in turn on context and the nature of overconfidence (and would be reversed were consumers underconfident rather than overconfident). For instance, a natural conjecture is that overoptimism about driving ability will lead drivers to underestimate the likelihood of filing a car-insurance claim.[3] If so, insurance companies should distort the price of filing a claim upwards, which means raising deductibles. The prediction that overconfidence increases deductibles is specific to insurance markets. In many cases, predictions about the consequences of overconfidence may be equally context-specific. However, overoptimism about self-control and overprecision each lead to more general predictions.

[1] Alternatively, when consumers have self-control problems, firms would like to set marginal price equal to the *commitment price* that induces efficient consumption (DellaVigna and Malmendier 2004).
[2] The result that marginal prices are distorted upwards when usage is underestimated and downwards when usage is overestimated appears in DellaVigna and Malmendier (2004) and Grubb (2009).
[3] Sundström (2008) and Benoît and Dubra (2011) discuss evidence for overoptimism about driving skill.

Misforecasting Usage Due to Overoptimism about Self-Control

First, consider overoptimism about self-control. DellaVigna and Malmendier (2004) define *investment goods* as those that require costly effort at the point of consumption but yield future benefits. In contrast, *leisure goods* are those that yield an immediate payoff upon consumption but are costly later. For example, a gym workout is an investment good but credit card borrowing is a leisure good. Those who are overoptimistic about their own levels of self-control will overestimate their consumption of investment goods (overestimating their gym attendance) but underestimate their consumption of leisure goods (underestimating credit card borrowing). As a result, DellaVigna and Malmendier (2004) predict that marginal prices of investment goods will be discounted below marginal cost but that marginal prices of leisure goods will be inflated above marginal cost. This prediction is consistent with the fact that many gyms do not charge per-visit fees to members, despite per-visit marginal costs of $3 or more. It is also consistent with evidence that high interest rates on credit card debt do not merely reflect the costs of default, but are substantially above marginal cost: Ausubel (1991) finds that banks are able to resell credit card debt for an average premium of 20 percent.

Misforecasting Usage Due to Overprecision

Next, consider how firms may exploit overprecision. A car lessor who exhibits overprecision may correctly forecast her median mileage but underestimate the variance of her driving needs around the median. Such a consumer will overestimate the likelihood of driving the qth mile if it is below median total mileage, but underestimate the likelihood of driving the qth mile if it is above median total mileage. Therefore, if Q is median mileage, the lease contract should price the first Q miles below marginal cost and all later miles above marginal cost. If consumers can freely dispose of miles (for instance by lending the car to a friend for a weekend trip) then the mileage fee for the first Q miles should not be reduced below zero. While the optimal contract will be fully nonlinear, a three-part tariff is a good approximation (Grubb 2009). A three-part tariff consists of: 1) a fixed fee; 2) an included allowance of units at zero marginal price; and 3) a constant marginal price for additional units. This coincides exactly with observed car leasing contracts, which typically offer an allowance of 36,000 miles with a three-year lease and charge 15 cents per mile for additional mileage. Overconfidence may explain the structure of car lease contracts as well as three-part tariffs in a variety of other settings. Table 1 gives some examples.

The literature on exploitative contracting focuses on how consumer bias affects firm pricing.[4] However, contracts often specify aspects of quality as well as price, and overconfidence should affect these terms as well. I conjecture that the preceding conclusions about marginal price distortions extend naturally to quality distortions. If a consumer overestimates the likelihood of using the qth unit, then she will

[4] Spence (1977) is an exception. See Kőszegi (2014) for a survey.

Table 1
Three-Part Tariffs

Product or service	*Consumers must forecast*	*Example contract*
Car lease	Mileage	Fixed price for 36 months and 36,000 miles plus 15 cents per additional mile (Toyota 2014).
Smart phone service	Data usage	$60/month for unlimited talk and text and 1GB of data plus $15 per additional 500MB of data (Verizon Wireless 2014).
Credit card	Loan duration	Introductory offer with an initial balance transfer: Banks charge a balance transfer fee that is independent of the loan duration. Then there are zero financing charges for the first six months but a high interest rate thereafter (Chase 2014).

Source: Author.

overvalue an increase in its quality, and the firm should overinvest in its quality. Similarly, if a consumer underestimates the likelihood of using the qth unit, then she will underestimate the cost of a quality reduction, and the firm should underinvest in its quality. Just as overprecision leads firms to charge zero marginal price up to a usage allowance followed by high marginal charges thereafter, overprecision could also lead firms to offer high-quality service up to a usage allowance followed by low quality thereafter.

These conjectures about optimal product quality may explain why T-Mobile offers cellular data plans that include an allowance of data at high speed but provide additional data beyond the allowance at slow speed. If overconfident consumers underestimate the variance of their total data usage, then inefficiently high speed should be provided up to an allowance after which inefficiently low speed should be provided. They may also explain coverage limits on car insurance. If overconfident consumers underestimate the variance of their accident losses, then they underestimate the likelihood of large losses and the firm should respond by reducing coverage quality for large losses. Coverage limits accomplish this objective. Table 2 summarizes both examples.

When Overconfidence Involves Overoptimism about Navigating Contract Terms

Now return to the case where overconfident consumers overvalue contracts because they overestimate their abilities to navigate contract terms. Taking full advantage of a contract often requires follow-through—remembering and then completing a costly task in the future, whether it be mailing in a rebate or canceling service once an introductory rate expires. Any contract term offering a future benefit after a costly task is completed presents two challenges. First, such terms create a *memory hurdle*. Overconfidence about prospective memory leads consumers to overestimate the likelihood of remembering to complete tasks and overvalue the contract to firms' benefit (Hollman and Zaidi 2010). Second, such terms serve as a *self-control trap* that exploits

Table 2
Product Quality Distortions

Product or service	*Consumers must forecast*	*Example contract*
Smart phone service	Data usage	$50/month for unlimited talk and text and 1GB of data at high speed. Additional data provided at slow speed (T-Mobile 2014).
Car insurance	Losses	Premium, deductible, and coverage limit beyond which 0 percent of additional loss is covered (Liberty Mutual 2014).

Source: Author.

overconfidence about self-control (DellaVigna and Malmendier 2004). If the cost and benefit of the task are correctly balanced (such that the ratio of benefit to cost is large enough but not too large), then an overconfident consumer will anticipate having the self-control to complete the task in a timely fashion, but in practice will either procrastinate and delay completing the task or fail to complete it altogether (O'Donoghue and Rabin 1999). This is a second reason that overconfident consumers overvalue the contract to the firm's benefit. Table 3 lists a few of the many contract terms that require follow-through. In each case, while there may be other explanations, firms may include the contract terms simply to exploit overconfidence about prospective memory, overconfidence about self-control, or both.

Beyond remembering tasks and exercising self-control, navigating contract terms as intended often also requires consumers to pay attention. For instance, a checking account customer who does not pay attention to her account balance can easily and unintentionally pay her bank $35 to buy a cup of coffee with her debit card, not realizing that her account balance is exhausted and that an overdraft fee applies. Stango and Zinman (2014) find that "60 percent of overdrafters reported overdrafting because they 'thought there was enough money in my account.'" Importantly, if banks designed overdraft fees simply to reflect the marginal cost of extending credit, then they should want to disclose overdraft fees at the point of sale to increase the social efficiency of consumers' choices. Card-processing terminals could be designed to ask a consumer, "Overdraft fee applies. Continue Yes/No?"—but they do not. Instead, the lack of transparency creates an *attention hurdle*, which consumers who are overoptimistic about their attention levels overestimate the likelihood of clearing, leading to contract overvaluation rather than increased efficiency.

Hidden fees are those that consumers may be unaware of when signing a contract because firms disclose them only in the fine print if at all. Whether or not overdraft fees are hidden fees, they are an example of something distinct: *surprise penalty fees*. These are fees that firms impose as a penalty for crossing a consumption threshold, but make a surprise by choosing not to notify customers when they reach the relevant threshold. Consumers can thus only avoid them by paying attention to approaching thresholds themselves. *Surprise loyalty discounts*, which lower rather than raise marginal

Table 3
Barriers to Follow-Through: Memory Hurdles and Self-Control Traps

Contract term	*Explanation*
Mail-in rebates	Overconfident consumers may overestimate the likelihood of remembering to mail in a rebate or of having the self-control to avoid procrastinating until the deadline is missed.
Free trials or teaser rates with switching or cancelation costs	When a free trial or teaser rate expires, the consumer must go to the trouble of switching or canceling to avoid the newly higher fees. Overconfidence about self-control or prospective memory both lead one to overestimate the likelihood of switching or canceling and achieving the benefits rather than procrastinating or forgetting.
Auto-renewal	Auto-renewal makes switching or quitting relatively more costly and can lead to overestimation of switching or quitting.
Bonus cash back (quarterly activation required)	Some credit cards offer additional cash back conditional on customers actively opting in each quarter. Overconfident consumers may overestimate the likelihood of opting in.

Source: Author.
Note: See DellaVigna and Malmendier (2004, 2006), Eliaz and Spiegler (2006), and Heidhues and Kőszegi (2010) for more examples.

price after crossing a consumption threshold, are also attention hurdles. For instance, the last flight required to achieve elite status is effectively discounted by the value of elite rewards. Yet frequent flyers must keep track of their mileage balances to know whether the implicit discount applies to a current trip. Consumers who are overoptimistic about their attention levels will underestimate the likelihood of paying surprise penalty fees but overestimate the likelihood of collecting surprise loyalty discounts. In either case, consumers overvalue contracts with attention hurdles to firms' benefit (Grubb 2015a). More examples are shown in Table 4.

More generally, if overconfident consumers overestimate their ability to clear hurdles and avoid traps in contract terms, then this makes it profitable to add such hurdles and traps to contracts. If consumers overestimate their ability to avoid fees of some kind then firms should add them to contracts. If consumers overestimate their ability to collect discounts, such as mail-in rebates, then firms should add them to contracts. While overconfidence is prevalent, consumers may also be underconfident about their abilities to complete some tasks. Including such tasks in contract terms would only lead consumers to undervalue contract surplus to firms' detriment. Thus, in equilibrium, we should only expect firms to complicate contracts with the sorts of tasks that consumers are overconfident they can complete.

Alternative Explanations for Complex Contracts

It is important to recognize that price-discrimination models with rational expectations can explain almost any pricing pattern, such as rebates (Narasimhan 1984),

Table 4
Attention Hurdles

Product or service	*Consumers must attend to*	*Source of returns to attention.*
Checking account	Account balance	Debit card transaction fee rises from $0 to $35 when balance falls to zero.
Credit card	Account balance	Crossing credit limit triggers over-limit fee*
Smart phone service (prior to 2013**)	Data usage	Marginal price of data rises from $0 to $15 per 500MB after 1GB of usage.
Frequent flyer program	Mileage balance	Perks are awarded upon crossing various mileage thresholds.

Source: Author.
* US over-limit fees are restricted by the 2009 Credit Card Accountability Responsibility and Disclosure (CARD) Act.
** By agreement reached with the Federal Communications Commission (FCC) in 2011, US carriers began alerting customers when they approached or exceeded usage allowances in 2013 (CTIA-The Wireless Association 2011).

menus of three-part tariffs (Grubb 2009), or (allowing for inattention) surprise penalty fees (Grubb 2015a). Moreover, there are often still more explanations for complex pricing strategies, other than either overconfidence or price discrimination. However, careful empirical work has shown that, in a variety of market settings discussed above, such models with unbiased consumers fail to simultaneously explain consumer behavior. As a result, consumer overconfidence can be a better explanation for observed pricing than any rational-expectations-based alternative.

For example, consider that three-part tariffs approximate the optimal contract for exploiting overprecise demand forecasts. Can we conclude that consumers are overprecise whenever firms offer three-part tariffs? The answer is "no," because three-part tariffs can also be optimal for price discrimination among unbiased consumers. However, I find that in the 2002–2005 US cellular phone service market, consumers' calling patterns are inconsistent with the price discrimination explanation.[5] This bolsters direct evidence of overprecision from consumers' calling plan choice mistakes and leads me to conclude that consumer overprecision is the best explanation in this market (Grubb 2009).

Such a conclusion can only be drawn on a market-by-market basis, and it remains a challenge to test the importance of consumer overconfidence across a broader array of markets. Nevertheless, the existing evidence is strong enough that consumer overconfidence should be a leading hypothesis in markets with pricing features like those described in Tables 1–4.

[5] Chao's (2013) alternative explanation of three-part tariffs is not applicable because it is based on a multistop shopping model, while most consumers contract with only one cellular phone service provider.

Complex Pricing is Robust to Competition

Competition does not eliminate complex forms of pricing that are designed to exploit overconfidence. Instead, its primary effect is to lower fixed fees.[6] When competition forces firms to offer more value to consumers, lowering fixed fees is optimal because, unlike lowering marginal fees or adjusting other contract terms, this does not diminish either the true surplus generated by a contract or the amount by which consumers overvalue contracts.

In fact, in a competitive market for a homogeneous good, a firm that simply priced at cost would fail to capture any market share. An example adapted from Grubb (2009) illustrates this point. Suppose that cellular service providers have marginal costs of 10 cents per minute and fixed costs of $40 per customer. Consumers value each minute of calling at 45 cents up to some satiation point, which they do not learn until after signing a contract. Consumer satiation points will either be 100, 400, or 700 minutes, each equally likely. However, overconfident consumers underestimate their uncertainty and believe they will be satiated at 400 minutes with probability 1. Cost-based pricing yields true and perceived utility of $400(\$0.45 - \$0.10) - \$40 = \$100$ to consumers. However, another firm could charge $60 for an allowance of 400 included minutes followed by 45 cent per minute charges for additional calling. In reality, this contract shifts $25 of surplus from consumers to firms, yielding expected profits of $25 and expected utility of $75. Absent overconfidence, no one would choose the contract. However, overconfident consumers perceive their expected utility to be higher, at $400(\$.45) - \$60 = \$120$, overvaluing the contract by $45, and will choose the contract over cost-based pricing.

Figure 1 shows the two pricing schemes graphically. An overconfident consumer expects to be in the shaded region of the figure where the three-part tariff is below cost. The firm recognizes, however, that two-thirds of the time the consumer will actually end up in the non-shaded regions where three-part tariff revenues are above cost. The contract serves as a bet about which region the consumer will end up in, and due to consumer overconfidence, both firm and consumers believe they will win on average.

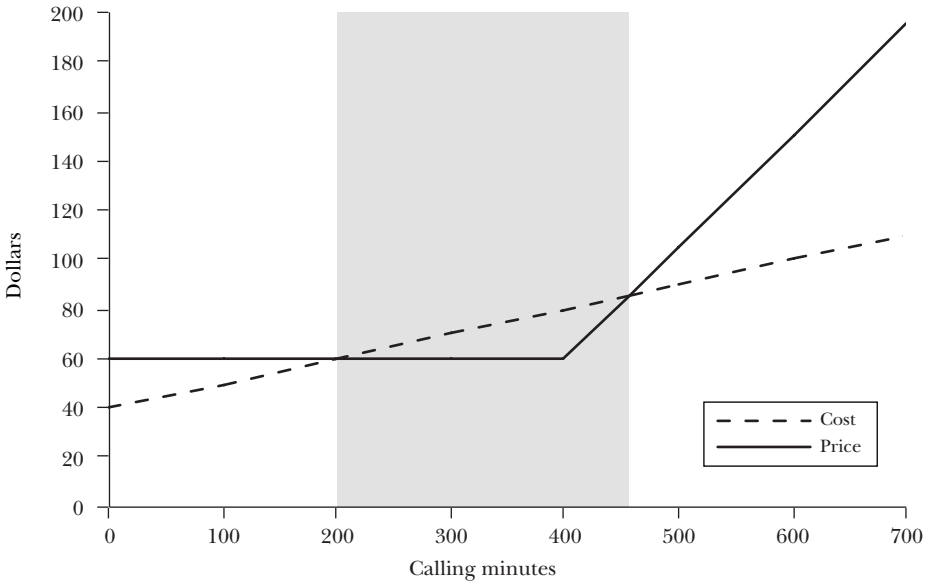
What Are the Equilibrium Welfare Consequences of Consumer Overconfidence?

How do firms, overconfident consumers, and society fare compared to a counterfactual world in which consumers have rational expectations? [7] Answering this question is useful for at least two reasons. First, doing so helps us better understand

[6] I assume one-stop shopping or exclusive contracting, where consumers buy from only one firm. For nonexclusive contracts, competition ensures that marginal prices do not exceed marginal cost (Gottlieb 2008).

[7] I measure welfare of an overconfident consumer as expected utility with respect to the true distribution of outcomes. See Bernheim (2009) and Beshears, Choi, Laibson, and Madrian (2008) for alternative views on the best approach.

Figure 1
Three-Part Tariff Pricing



Source: Author.
Notes: Suppose that cellular service providers have marginal costs of 10 cents per minute and fixed costs of $40 per customer. One firm prices at cost while another firm offers the three-part tariff shown, charging $60 for an allowance of 400 included minutes plus 45 cents per minute for additional calling. In the example described in the text, overprecise consumers choose the three-part tariff because they anticipate their usage always falling inside the gray-shaded interval, where the contract is below cost. The three-part tariff is profitable on average, however, because consumers turn out to consume in the profitable non-shaded regions more often than not.

how markets operate with overconfident consumers. Second, while no magic wand exists to wave away overconfidence, feasible policies can sometimes reduce contract overvaluation, thereby having the same effect on market outcomes as reducing consumer overconfidence.

Answering the welfare question requires first addressing another: Will overconfident consumers over- or undervalue equilibrium contract offers? The answer affects whether overconfidence raises or lowers industry profits, harms or helps consumers, and whether overconfidence expands or contracts the market. If overconfident consumers are overoptimistic about their own levels of self-control, prospective memory, or attention, and hence their ability to take advantage of a contract's potential value, then they overvalue contracts. For example, an individual overconfident about his own self-control overestimates his future gym attendance and hence his value of a gym membership. In contrast, if overconfident consumers misforecast their future usage because they misforecast their future valuations for the service, then they might undervalue contracts. Undervaluing car insurance due to overoptimism about

driving ability is a clear example. Less obvious is the fact that overprecision in demand forecasts can also lead to contract undervaluation (Grubb 2009).

As overconfidence in different contexts can lead to either overvaluation or undervaluation of contracts, both are relevant possibilities. From a firm's perspective, contract overvaluation is equivalent to an upward shift in demand. Typically this increases both prices and sales of contracts, to the benefit of firms but the detriment of infra-marginal consumers who pay the price increase. The reverse is true for contract undervaluation: prices and sales typically fall to the detriment of firms but the benefit of infra-marginal consumers. In either case, consumers on the margin are harmed. Contract overvaluation lures new consumers into paying a price above the value of the contract, while contract undervaluation discourages marginal consumers from accepting a good deal.

The social costs of overconfidence are less dependent on whether consumers overvalue or undervalue contracts. In either case, overconfidence distorts allocations, creating deadweight losses in competitive markets. In particular, overconfidence distorts allocations on both intensive and extensive margins, which Heidhues and Kőszegi (2015) dub the *exploitation* and *participation* distortions, respectively. The exploitation distortion arises because the pricing policies that optimally exploit overconfidence also distort consumer quantity choices on the intensive margin. For instance, overage rates on a cellular service plan may exploit overprecision, but also inefficiently suppress calling or data usage that is valued above its marginal cost. The participation distortion arises because overvaluation causes too many consumers to sign contracts, while undervaluation causes too few consumers to sign contracts.

In competitive market settings in which outcomes would be efficient absent overconfidence, then both distortions on intensive and extensive margins unambiguously lower social welfare. A caveat is that overconfidence could be welfare-improving if the distortions due to overconfidence are countervailing to other distortions already present in the marketplace. In particular, if market participation is already inefficiently low due to market power, then market expansion due to contract overvaluation can increase social welfare, albeit at consumers' expense.

Contract Overvaluation Benefits Firms but Hurts Consumers and Society in Competitive Markets

The informal discussion above claims that overconfidence with contract overvaluation typically benefits firms, harms consumers, and in competitive markets, harms society. Next, I describe a framework that makes this claim precise, and shows how the magnitude of the effects depend on two important market statistics—the elasticity of demand and the pass-through rate, which measures the fraction of an infinitesimal per-unit cost increase that is passed-through to consumers as a price increase.

Figure 2 illustrates the consequences of overconfidence with contract overvaluation in a perfectly competitive market. As is common in this kind of partial-equilibrium analysis, I omit income effects by assuming quasi-linear utility,

and I do not allow for firm entry or exit. Moreover, I proceed via the use of two tricks.[8] Pricing contracts are described by a fixed payment P and a vector of additional terms $\boldsymbol{p}$. For instance, an insurance contract charges a fixed premium (P) but also specifies coverage limits, deductibles, and co-insurance rates ($\boldsymbol{p}$). My first trick is standard: Given rational expectations (RE), I focus on the fixed payment (P_{RE}) as the "price" of the contract. Additional terms I treat like dimensions of product quality; I fix them at their equilibrium values ($\boldsymbol{p}_{RE}$) and suppress them from the graphical analysis. One can think of the contract simply as a product that delivers true expected utility U for price P_{RE}. Given rational expectations, this yields familiar demand and supply curves for contracts in Figure 2.

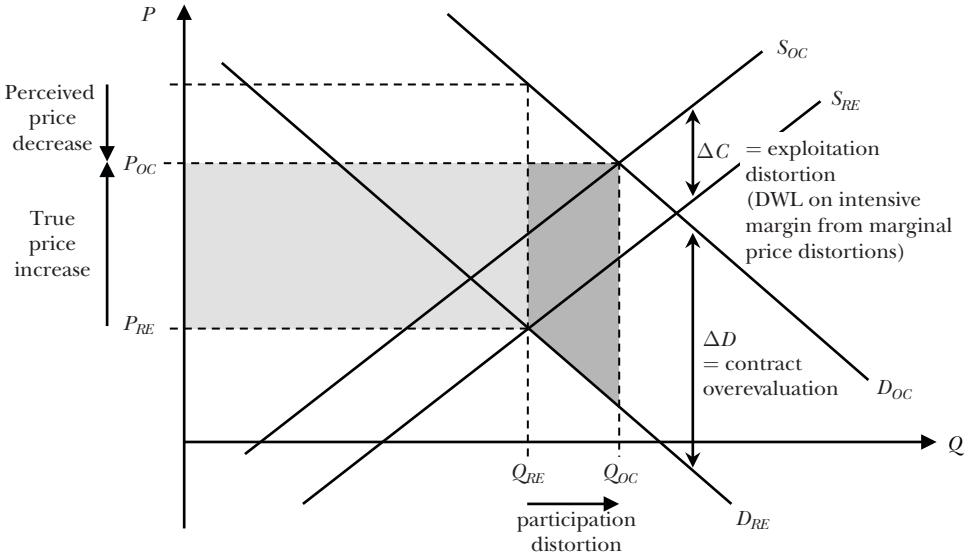
Analyzing demand and supply curves on the same figure for the case of overconfidence (OC) requires a second trick. As discussed earlier, consumer overconfidence will lead firms to complicate a contract's additional terms to include memory hurdles, self-control traps, or attention hurdles, or to create three-part tariffs or quality distortions. To make these more complicated contracts comparable to those offered under rational expectations, I partition the contract's fixed payment into two parts. These are the "price" of the contract (P_{OC}) and a second fixed fee F to be included with the additional terms $\boldsymbol{p}_{OC}$ that are suppressed from the analysis. The second fixed fee is chosen so that, gross of the price P_{OC}, the additional contract terms offered to overconfident consumers (F, $\boldsymbol{p}_{OC}$) yield the same true expected utility U as the additional contract terms ($\boldsymbol{p}_{RE}$) offered under rational expectations. As a result, regardless of whether one considers the case of rational expectations or overconfidence, one can treat offered contracts simply as products that deliver true expected utility U.

A numerical example can help to clarify how this method works. Given rational expectations, a wireless plan might charge \$50 per month for unlimited talk time. In this case the "contract" is "unlimited talk" and its "price" is \$50. Given overconfidence, a wireless plan might charge \$40 per month for 500 included minutes and charge \$0.50 per minute thereafter. This might lead consumers to make fewer calls, thereby losing \$5 in value from foregone calls, and to pay \$10 in additional calling charges. In this case the "contract" is "500 included minutes and \$0.50 thereafter with a \$15 refund" and its "price" is \$55. The \$15 adjustment to the definition of the "contract" offsets the \$5 in foregone calls and the \$10 in additional calling charges. Thus, both contracts offer consumers comparable value when considered gross of their respective prices.

Figure 2 plots contract demand and supply curves under both rational expectations and consumer overconfidence. On the demand side, and given rational expectations, a consumer's value for a contract is the difference between its utility and her outside option. The rational expectations demand curve is downward sloping, rather than a horizontal line, because consumers have heterogeneous outside options. Given overconfidence, the demand curve is shifted upwards by

[8] Previous graphical treatments of welfare given distinct curves describing demand and consumer valuations include Bernheim and Rangel (2009), Madrian (2014), and Spinnewijn (2014).

Figure 2
Consequences of Contract Overvaluation Due to Overconfidence in a Competitive Market



Source: Author.
Notes: The figure illustrates the consequences of overconfidence with contract overvaluation in a perfectly competitive market, plotting contract demand and supply curves under both rational expectations (RE) and consumer overconfidence (OC). "DWL" is deadweight loss. See text for details.

ΔD, the amount that consumers overvalue the offered contract. While the overconfident demand curve determines price and quantity with overconfidence, the rational expectations demand curve is still relevant for welfare calculations with overconfidence because it describes consumers' true valuations.

On the supply side, overconfidence leads to the exploitation distortion—a deadweight loss on the intensive margin equal to ΔC for each customer served. Overconfidence therefore shifts the supply curve upward by this amount, which reflects firms' increased cost of delivering the same true utility U to consumers. (If contract overvaluation results from overoptimism about ability to navigate contract terms, then this shift must be smaller than the shift in demand, as otherwise the contract terms would not be optimal for firms.)

The presence of overconfidence causes demand and supply curves to shift. It causes the equilibrium price to rise from P_{RE} to P_{OC}, and equilibrium quantity to increase from Q_{RE} to Q_{OC}. There are two losses to consumer surplus. First is the area shaded light gray, corresponding to the true price increase borne by existing customers. Second is the area shaded dark gray, corresponding to the amount new customers pay above their true valuations. Deadweight loss to society includes waste on the intensive margin ($\Delta C \cdot Q_{RE}$) captured by the upward shift in the supply

curve, and waste on the extensive margin (the dark gray area between S_{OC} and D_{RE}) due to inefficiently high contract sales.

The magnitudes of consumer harm and deadweight loss depend on how much price and quantity increase, which in turn depends on two important market statistics: the elasticity of demand and the pass-through rate. In perfectly competitive markets, the pass-through rate varies between 0 and 1 according to the elasticities of supply and demand: $\rho = \epsilon_S/(\epsilon_S - \epsilon_D)$. Given a constant market pass-through rate, ρ, the true price increase for a contract offering utility U is a weighted average of the shifts in demand and supply:

$$P_{OC} - P_{RE} = (1 - \rho)\Delta D + \rho\Delta C.$$

Due to contract overvaluation, however, consumers perceive a price decrease of $\rho(\Delta D - \Delta C)$, which increases sales according to the elasticity of demand.[9]

When the pass-through rate is zero, firms raise the price of a contract offering utility U by the amount consumers overvalue the contract, ΔD. Consumers perceive no effective change in the price. Firm profits per customer, however, rise by the price increase less the deadweight loss from distortions on the intensive margin, $(\Delta D - \Delta C)$. When the pass-through rate is positive, firms pass fraction ρ of these potential profits back to consumers. Consumers perceive this to be a price cut of $\rho(\Delta D - \Delta C)$ when in truth it merely reduces the price increase to $(1 - \rho)\Delta D + \rho\Delta C$.

As highlighted in Table 5, there are several implications for welfare. First, a high pass-through rate near 1 protects infra-marginal consumers from their overconfidence by limiting true price increases but, for the same reason, tempts more consumers on the extensive margin to buy at prices above their true valuations by increasing the perceived price drop. In contrast, a zero pass-through rate eliminates the participation distortion (unless demand is perfectly elastic), but maximizes the harm to infra-marginal consumers. Next, while deadweight loss on the intensive margin from the exploitation distortion is always $\Delta C \cdot Q_{RE}$, the participation distortion relies both on consumers perceiving a price drop and on them being responsive to it. Thus, there is no participation distortion either when the pass-through rate is zero and demand is not perfectly elastic, or when demand is perfectly inelastic. In contrast, the participation distortion (and hence the total social cost of overconfidence) is largest when pass-through is high and demand is elastic.

If firms have market power, neither Figure 2 nor the conclusion about total deadweight loss in Table 5 applies. However, the expressions which relate true and perceived price changes to the market pass-through rate are the same. Thus, given a market pass-through rate less than one, contract overvaluation leads to a true price increase but additional sales due to a perceived price drop, which is good for

[9] In similar analyses using the market pass-through rate, Agarwal, Chomsisengphet, Mahoney, and Stroebel (2014) describe the effect of regulating hidden fees on up-front prices, and Farrell (2008) describes the welfare loss when consumers underestimate aftermarket costs.

Table 5
Welfare Consequences of Contract Overvaluation Due to Overconfidence in a Perfectly Competitive Market

Setting	*Outcome*
$\rho = 0$ and $\epsilon_D > -\infty$	No participation distortion or harm to marginal consumers. Minimum deadweight loss ($\Delta C \cdot Q_{RE}$). Maximum price increase (ΔD) to infra-marginal consumers.
$\rho = 1$ and $\epsilon_D = 0$	No participation distortion or harm to marginal consumers. Minimum deadweight loss ($\Delta C \cdot Q_{RE}$). Minimum price increase (ΔC) to infra-marginal consumers.
$\rho = 1$ and $\epsilon_D \ll 0$	Maximum participation distortion and harm to marginal consumers. Maximum deadweight loss. Minimum price increase (ΔC) to infra-marginal consumers.

Source: Author.

firms but bad for consumers, whether firms have market power or not. A difference from the competitive case is that the additional contract sales may be socially valuable if they offset otherwise inefficiently low sales due to market power. Finally, and unlike in a competitive market, the market pass-through rate can exceed one with market power, which implies that contract overvaluation could conceivably benefit infra-marginal consumers by lowering prices.[10]

Contract Undervaluation Harms Firms and Society but May Benefit Some Consumers in Competitive Markets

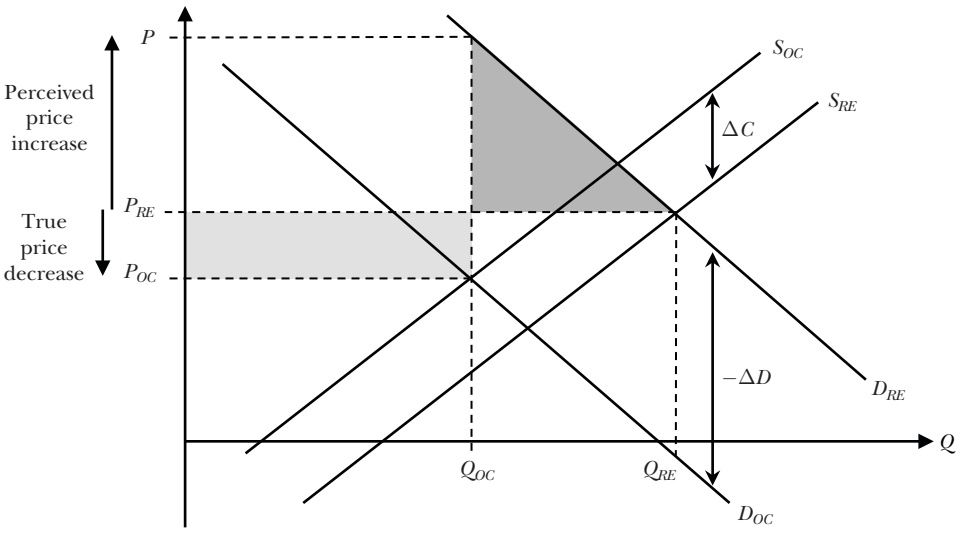
When overconfident consumers misforecast their future valuations for services, they may undervalue contracts. In this case, overconfidence shifts demand downwards relative to rational expectations and may depress the market price.[11] This is bad for firms but good for infra-marginal consumers who enjoy the lower price. On the extensive margin, however, some consumers with true contract valuations above the price will stop buying to their own detriment. Thus, the overall effect of overconfidence on consumer surplus may still be negative. Moreover, absent any source of inefficiency other than overconfidence, overconfidence remains unambiguously bad for social welfare in a perfectly competitive market.

Figure 3 is similar to Figure 2 but depicts the case in which overconfidence leads to sufficient *under*valuation of the contract to depress its market price.

[10] Given a constant pass-through rate, this occurs if $\rho > \Delta D/(\Delta D - \Delta C)$. Whether ρ exceeds this threshold depends on the curvature of the logarithm of demand, which increases pass-through given market power (Weyl and Fabinger 2013).

[11] Expressions for price changes from the preceding section continue to hold, so price falls if $\Delta D < -\Delta C \frac{\rho}{(1-\rho)}$.

Figure 3
Consequences of Contract Undervaluation Due to Overconfidence in a Competitive Market



Source: Author.
Notes: The figure illustrates the consequences of overconfidence with contract undervaluation in a perfectly competitive market, plotting contract demand and supply curves under both rational expectations (RE) and consumer overconfidence (OC). See text for details.

Overconfidence causes the equilibrium price to fall from P_{RE} to P_{OC}, and equilibrium quantity to fall from Q_{RE} to Q_{OC}. Firm profits fall with demand. Deadweight loss to society includes the area between the supply curves (waste on the intensive margin) and the lost surplus due to inefficiently low contract sales (waste on the extensive margin). There are two changes to consumer surplus. First, infra-marginal customers benefit from the true price decrease, benefiting by the area shaded light gray. Second, consumers on the extensive margin lose the area shaded dark gray because their undervaluation causes them to forego purchasing contracts with true expected value above their price. The net effect for consumer surplus may be positive or negative. Nevertheless, overconfidence remains socially costly, as lost profits more than offset any consumer benefit.

Does Competition (Partially) Protect Consumers from Overconfidence?

Suppose that overconfidence leads consumers to overvalue contracts. Then in competitive markets, as discussed above, overconfident consumers are worse off than they would be in a counterfactual world with rational expectations. Thus, competition does not completely protect consumers from overconfidence. However, one may still ask whether competition partially protects consumers from overconfidence. First, does increased competition benefit overconfident consumers? Second,

consider policies that directly reduce contract overvaluation, for instance by limiting the use of contract terms described in Tables 1–4. Does competition reduce the consumer harm from overconfidence and thereby limit the potential benefit from such policies?

A common assumption in the literature is that competition increases the market pass-through rate and that there is full market coverage, meaning that all consumers buy and are infra-marginal.[12] Under this assumption, the answer to both questions is "yes." Infra-marginal consumers always benefit from lower prices and so benefit from competition. Moreover, if competition raises the pass-through rate it also limits the amount by which contract overvaluation raises prices, and hence limits the cost of overconfidence to infra-marginal consumers. Thus competition reduces returns to consumer protection policies that directly reduce contract overvaluation.

Perhaps surprisingly, however, when the full-market coverage assumption is relaxed, the answer to both questions is "not necessarily." The reason is that competition and low prices have very different welfare consequences for marginal consumers than for infra-marginal consumers. In particular, while lower prices always benefit infra-marginal consumers who pay less, lower prices can actually harm marginal consumers who overvalue contracts. As a result, competition can have counterintuitive effects on consumer welfare.

Accounting for contract overvaluation, consumers just indifferent to buying are actually strictly worse off buying than not. These consumers would be protected by high prices that keep them out of the market. Reduced prices due to competition can tempt them to buy when they should not. It is therefore possible that policies that successfully increase competition, lower prices, and expand sales also lower consumer surplus.

Moreover, while competition that raises the pass-through rate reduces the true price increase that results from contract overvaluation, it simultaneously increases any perceived price decrease due to contract overvaluation. Thus while competition mitigates the cost of overconfidence to infra-marginal consumers, it increases the costs to marginal consumers, more of whom are lured into the market to pay more than their true valuations.[13] Therefore, while we might say that competition partially protects infra-marginal consumers from overconfidence, we might also say that market power partially protects marginal consumers from overconfidence (by pricing them out of the market). If demand is elastic, then the latter effect may be important, and competition may increase returns to policies that reduce contract overvaluation.

[12] For example, DellaVigna and Malmendier (2004) assume marginal cost is constant and all consumers have the same outside option. Thus all consumers buy, and pass-through is zero for monopoly but one for perfect competition.

[13] This prediction is reversed if competition decreases rather than increases the pass-through rate, as is certainly possible (Bulow and Pfleiderer 1983; Weyl and Fabinger 2013).

Pooling and Cross-Subsidization

Thus far in my discussion, it may seem that consumer harm is limited when the pass-through rate is high and market demand is very inelastic (Table 5, row 2). This is only true, however, when all consumers are equally overconfident. Consider an example inspired by Gabaix and Laibson (2006). There is a competitive market for checking accounts with a perfectly elastic supply of accounts. A bank's marginal cost of processing an overdraft transaction is zero but the typical fee is $35. All consumers opening checking accounts believe they will pay attention to their balance and avoid overdraft fees. Half of them have rational expectations and do avoid fees. Half, however, are overconfident about their attention and in fact incur $100 in overdraft fees due to inattention.

Given the assumption that supply is perfectly elastic, banks cannot profit from consumer overconfidence. If all consumers were overconfident, annual fees for checking accounts would be $100 below cost and banks would break even with overdraft fee revenue. The market pass-through rate of one ensures that 100 percent of the overdraft fees, which overconfident consumers fail to anticipate paying, are passed back to consumers through lower account fees. The only harm to overconfident consumers would be on the extensive margin. Some who valued checking accounts below cost would be lured to open an account by underestimating its true cost.

How is the welfare of overconfident consumers affected when half of consumers are rational? One might hope that the presence of rational consumers might provide a positive externality that helps protect overconfident consumers. We know, for instance, that consumers with low search costs can benefit others by lowering equilibrium prices for all. Unfortunately, however, the presence of rational consumers does not protect the overconfident from harm. On the contrary, rational consumers can exert what Armstrong (2015) dubs a negative *rip-off externality* on the overconfident, raising the prices they pay.

In this example, when equal numbers of consumers are rational and overconfident, annual checking account fees are priced only $50 below cost. Banks still pass 100 percent of overdraft fee revenue back to consumers in lower fees. Now, however, the account fee reduction is shared equally between overconfident consumers who pay the overdraft fees and rational consumers who do not. As a result, infra-marginal overconfident consumers now pay $50 above cost for their accounts. This overpayment does not accrue to firms, who still make zero profit, but to rational consumers, who receive the $50 as a cross-subsidy. The only overconfident consumers to benefit from the presence of rational consumers are those on the extensive margin who are dissuaded from opening an account when the account fee is $50 below cost rather than $100 below cost.

In short, even when a high pass-through rate prevents firms from exploiting infra-marginal overconfident consumers, they may still be in danger. Rational consumers who choose the same contracts and receive cross-subsidies may exploit them instead. In practice, this redistribution between consumers can be large: in 2013, US overdraft fees totaled $32 billion (Andriotis 2014), but Stango and Zinman (2009, 2014) find that these fees are paid by less than half of account holders. In fact,

just 16 percent of account holders pay over 70 percent of overdraft fees. Because this group tends to be lower income than the general population, the cross-subsidies from the fee payers to the free riders are regressive (Parrish and Frank 2011).

Consumer Protection Policy

Overconfidence may harm consumers in many ways. Indeed, firms continually invent new ways to exploit consumer overconfidence because the returns to such *exploitative* innovation equal or exceed returns to traditional innovation that increases product value (Heidhues, Kőszegi, and Murooka forthcoming). By describing the costs of overconfidence, the previous section shows that policies that mitigate its effects would be valuable, even in competitive markets. Researchers have proposed at least three practical approaches for addressing overconfidence: 1) requiring disclosure to guide contract choice, 2) requiring disclosure to aid contract navigation, and 3) restricting pricing terms.

Bar-Gill (2012) makes the case for the first approach. As overconfident consumers misforecast costs and benefits of contracts, the proposal is to require firms to disclose expected costs and benefits up front. For example, consider a cellular service plan that charges a monthly fee plus additional charges for usage beyond allowances. Disclosing contract terms does not prevent overconfident consumers from misforecasting its cost because the additional charges are a function of future usage. Three possible additional disclosure requirements are imagined. First, the seller could disclose the average monthly bill across all existing customers of the plan (which I find in Grubb, 2009, to be 90 percent higher than the monthly fee in a 2002–2005 panel of students' cellular phone bills). Second, if the seller already has a relationship with a customer, it could personalize the disclosure by reporting what the average monthly bill would be if evaluated at the customer's own past usage levels. Third, as advocated by Thaler and Sunstein (2008), sellers could let customers easily share their entire usage and billing history with third parties who could then give personalized advice about the expected costs of all calling plans in the market. Plans are already underway in the UK to implement this third disclosure requirement in retail energy markets (Department of Energy & Climate Change and Davey 2014) and the retail banking market (Competition & Markets Authority 2014).

The second approach to addressing overconfidence—requiring disclosure to aid contract navigation—has been implemented in both EU and US cellular phone service markets. EU and US consumers must be alerted to roaming rates upon crossing national borders, and US consumers must be alerted as they approach or exceed usage allowances (European Commission 2011; CTIA-The Wireless Association 2011). Such disclosures can make overoptimism about attention to roaming boundaries or usage allowances irrelevant, as the alerts can substitute for consumers' own attentiveness (Grubb 2015a). Extending this policy to retail banking, by requiring point-of sale overdraft warnings, could have substantial benefits (Armstrong and Vickers 2012; Grubb 2015a).

The third approach to addressing overconfidence—regulating prices—is naturally more controversial than a disclosure requirement. In the context of overoptimism about self-control, DellaVigna and Malmendier (2004) argue that price regulation requires too much information (about firm costs, market structure, and consumer preferences) to be practical. Heidhues and Kőszegi (2010) are more optimistic, however, and advocate "prohibiting disproportionately large penalties for deferring small amounts" of repayment in credit markets. They argue that a prohibition would limit exploitation of overoptimism about self-control and would have no downside—as there is unlikely to be any efficiency rationale for the fees. Similar bans of any of the contract terms outlined in Tables 1–4 might also be considered but would have to be carefully weighed against possible drawbacks. For instance, banning three-part tariffs in car leasing (and forcing firms to use two-part tariffs with a constant per-mile charge) would prevent exploitation of overprecise mileage forecasts but could be socially costly if depreciation is nonlinear in mileage.

I hope that regulatory intervention can help ameliorate negative consequences of overconfidence. In evaluating regulatory proposals, however, it is crucial to anticipate equilibrium responses of firms. Correcting individual decision-making errors will often have smaller benefits when equilibrium considerations are taken into account. In some cases, de-biasing consumers can actually cause consumer harm by increasing the prices they pay. For instance, eliminating contract undervaluation can raise prices. Alternatively, de-biasing a fraction of overconfident consumers can exacerbate cross-subsidies paid by those who remain overconfident.[14] Importantly, as identified in the previous section, market pass-through rate and elasticity of demand are useful market statistics for understanding what the equilibrium effects will be. To illustrate this point, consider contrasting cases of intervention in the cellular phone service and credit card markets.

First, by agreement reached with the Federal Communications Commission (FCC) in 2011, US carriers began alerting customers when they approached or exceeded usage allowances in 2013 (CTIA-The Wireless Association 2011). Using a structural model estimated with 2002–2005 student billing data, counterfactual simulations predict that, had the agreement been implemented during the sample period, it would have benefited the average consumer by about $100 annually were prices held fixed. However, when firms' equilibrium pricing response is taken into account, average monthly fees increase to offset lost overage revenue, and the prediction is that the average consumer does not benefit (Grubb and Osborne 2015).

Second, the US 2009 Credit Card Accountability Responsibility and Disclosure (CARD) Act required increased disclosure by credit card lenders and restricted a variety of fees, including over-limit and late-payment fees. The fee restrictions limit the ability of credit card lenders to exploit overoptimism about self-control

[14] See also Mullainathan, Schwartzstein, and Congdon (2012); Handel (2013); Spiegler (forthcoming); and Grubb (2015a) for examples of improved individual decisions worsening equilibrium outcomes.

(Heidhues and Kőszegi 2010) as well as overoptimism about attention to balances and dates. Agarwal et al. (2015) estimate that the CARD act lowered over-limit and late-payment fees of US credit card users by $11.9 billion annually. Moreover, they estimate that there was zero offsetting increase in interest rates or other fees, and zero reduction in available credit. As a result, US consumers really are better off by $11.9 billion per year.

Both cellular usage alerts and restrictions on credit card over-limit fees should reduce any contract overvaluation that arises due to overprecise calling or borrowing forecasts, or due to overoptimism about attention to calling or borrowing levels. Why then should the CARD act benefit consumers so much more than the FCC's agreement with cellular carriers? The answer follows from Table 5. In Grubb and Osborne (2015), we estimate that the market for cellular service is highly inelastic (few would give up their cellphones if industry prices went up 1 percent) and has a high pass-through rate near 1. This corresponds to row 2 of Table 5, the case for which consumer benefits of regulation are most limited. In contrast, as Agarwal, Chomsisengphet, Mahoney, and Stroebel (2014) point out, Ausubel (1991) finds almost no pass-through of changes in credit card lenders' costs of funds to credit card interest rates. A zero pass-through rate corresponds to row 1 of Table 5. In this case, regulation is expected to have large benefits to infra-marginal consumers without affecting marginal consumers—exactly as found in Agarwal, Chomsisengphet, Mahoney, and Stroebel (2015).

Why should the pass-through rate differ so much between the cellular and credit card markets? One possibility is that the pass-through rate is zero in the credit card market because binding price floors prevent lenders lowering up-front fees—they may be unable to lower annual fees below zero or raise cash back above receipts from interchange fees without attracting arbitrageurs (Heidhues, Kőszegi, and Murooka forthcoming). Otherwise, as explained by Weyl and Fabinger (2013), pass-through rates vary with the shape of industry cost curves and demand curves, so should be expected to vary across markets.

Conclusion

Overconfidence causes consumers to misweight different contractual terms and product attributes, and so to misforecast costs and benefits of offered products and services. Firms respond by designing contractual terms to increase consumer overvaluation of their products. Consumer harm and deadweight losses result. Happily, practical policies mandating disclosure or restricting contract terms may reduce contract overvaluation—if not overconfidence itself. Naturally, regulation that restricts pricing has the potential for harmful unintended consequences and should be pursued cautiously. Moreover, in some cases, the potential upside from intervention may be limited. Yet, two market statistics, the pass-through rate and the elasticity of demand, can help identify markets most conducive for intervention. Finally, the remarkable success of policies such as the 2009 Credit Card

Accountability Responsibility and Disclosure (CARD) Act suggest that policymakers with a consumer protection mandate should look for more opportunities to ameliorate consequences of overconfidence—and in fact any other bias, such as projection bias or salient thinking, that leads to systematic misweighting of contractual terms.

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