IMPERFECT COMPETITION IN SELECTION MARKETS

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Abstract—Policies to correct market power and selection can be misguided when these forces coexist. We build a model of symmetric imperfect competition in selection markets that parameterizes the degree of market power and selection. We use graphical price-theoretic reasoning to characterize the interaction between these forces. Using a calibrated model of health insurance, we show that the risk adjustment commonly used to offset adverse selection can reduce coverage and social surplus. Conversely, in a calibrated model of subprime auto lending, realistic levels of competition can generate an oversupply of credit, implying that greater market power is desirable.

I. Introduction

In health insurance markets, risk adjustment is increasingly used to offset the adverse selection that occurs when consumers with higher medical costs select more generous health plans (e.g., Brown et al., 2014). Reducing adverse selection, however, may be misguided when insurance plans have market power. The reason is that firms facing adverse selection have an incentive to lower their prices to encourage lower-cost "young invincibles" to buy their product. Risk adjustment, precisely because it offsets adverse selection, undermines this incentive and can lead to higher prices and lower social surplus.

Conversely, in consumer lending markets, some degree of market power can be helpful. In a perfectly competitive market, lenders have an incentive to reduce down-payment requirements to attract profitable inframarginal customers from their rivals. These lower down payments draw in high-risk marginal borrowers, to whom loans are socially wasteful. A monopolist lender would internalize these cream-skimming externalities, potentially increasing social surplus.

Thus, selection and imperfect competition interact in rich, surprising, and potentially socially important ways. Yet despite these features, we are unaware of any systematic analysis of imperfect competition in selection markets. In this paper, we try to fill this gap with a price-theoretic model that builds on the existing literature on both topics and can be analyzed graphically to provide intuition.

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We start by presenting a model of symmetric imperfect competition in selection markets. To abstract from a particular model of imperfect competition (such as Bertrand or Cournot), we use the conduct parameter approach pioneered by Bresnahan (1989) and further developed in Weyl and Fabinger (2013). Market power is indexed by a parameter θ that nests, as special cases, monopoly, perfect competition, versions of symmetric Cournot competition (with or without conjectural variations), and differentiated-products Bertrand competition.

This one-dimensional conduct parameter approach is enabled by the assumption that consumers' willingness to pay is distributed symmetrically across products. To add selection to this model, we need to strengthen this notion of symmetry to account for variation in the cost of providing the product to different consumers. Following Rochet and Stole (2002) and White and Weyl (2016), we assume that at symmetric prices, each firm receives a sample of consumers with costs that are representative of all consumers purchasing the product and that a firm that cuts its price steals consumers with a similarly representative distribution of costs from its competitors.

These assumptions allow us to parameterize the degree of selection—arising from different correlations between willingness to pay and costs across markets—with a single parameter σ. We define $\sigma = 1$ to be the complete selection baseline set to the maximum amount of selection that can occur in the model and no selection ($\sigma = 0$) to occur when willingness to pay and costs are uncorrelated. Reducing the degree of selection moves individuals toward having the costs of the average individual in the full population. A particularly useful feature of our model is that changes in σ isolate the effect of changes in the degree of selection, holding fixed the full population's average costs.

We use this model to examine the welfare effects of changes in the degree of market power in industries with selection and changes to the degree of selection in industries with market power. Increasing the degree of market power always reduces the amount of the product supplied, so its social utility depends on whether supply under perfect competition is excessive or insufficient. Under adverse selection, there is undersupply with perfect competition, and market power is harmful because it exacerbates this distortion. Under advantageous selection, there is oversupply with perfect competition, and social surplus is inverse-U-shaped in market power because market power, up to a point, mitigates the excess supply created by advantageous selection.

The effect of changing the degree of selection is subtle and depends on the direction of selection, the prevailing quantity in the market, and the degree of market power. A monopoly firm, for example, internalizes the costs of its marginal consumers. When there is adverse selection and fewer

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consumers are in the market, the marginal consumers will tend to be more costly than the population average, and reducing the degree of selection will thus lower costs and the price that the monopolist charges. When there are many consumers in the market, marginal consumers will be less costly than the population average, and reducing the degree of selection will raise costs and the monopolist's price.

The welfare effects of changes in selection are even subtler, as they depend on the source of the change in selection. If selection is reduced by the implementation of risk adjustment, then welfare is determined entirely by whether quantity moves toward its socially optimal level under the non-risk-adjusted costs. When the underlying primitives change, shifts in the degree of selection have a direct impact on welfare by affecting the social cost of providing the product.

We illustrate the implications of our results with three applications. The first application is to a canonical problem in competition policy: the merger of two symmetric competitors to monopoly. We show that several standard intuitions embodied in the latest revision of the U.S. Horizontal Merger Guidelines (U.S. Department of Justice and Federal Trade Commission, 2010, henceforth HMG) are reversed in selection markets. For example, advantageous selection can generate large values of upward pricing pressure (UPP), a standard indicator used to assess a prospective merger's harm. However, since markets with advantageous selection can have too much competition, UPP can be large exactly in settings where additional market power can be socially beneficial.

Our other two applications flesh out the examples we used to motivate our analysis. First, we build a model of health plan choice and calibrate it to data and empirical estimates on the U.S. employer-sponsored insurance market (Dafny, Duggan, & Ramanarayanan, 2012; Handel, Hendel, & Whinston, 2015). For the baseline parameter values, and indeed most parameter values consistent with the empirical literature, risk adjustment has the unintended consequence of reducing surplus received by the employer and its workers and often harms social welfare. To examine the effects of market power in consumer lending, we calibrate a model of subprime auto lending to the data in Einav, Jenkins, and Levin (2012). We show that in this market, which has severe advantageous selection due to limited information on borrower creditworthiness, a realistic degree of competition generates a significant oversupply of loans, providing a cost subsidy to the marginal borrower of 41%. While these calibrations do not substitute for careful empirical analysis, they suggest that the forces we highlight may be quantitatively important in canonical empirical contexts.

While our analysis is general along some dimensions, its simplicity depends on a number of stylized assumptions. Most important, we assume that products are symmetric(ally differentiated) and that their (nonprice) characteristics are exogenously determined. We thus rule out adjustment by either consumers or firms along the dimension of product quality. While some violations of symmetry across products, such as having a firm that is horizontally (and orthogonally to costs) viewed as more desirable by more consumers, is probably innocuous, allowing adjustments along the quality dimension would likely change our results in important ways. In particular, Veiga and Weyl (2016) show that market power typically has additional social benefits in the presence of selection, as it limits firms' incentives to engage in socially wasteful design of products to "cream-skim" from their rivals, a point originally emphasized in Rothschild and Stiglitz (1976).

Our paper is closely related to Einav, Finkelstein, and Cullen (2010) and Einav and Finkelstein (2011), who conduct a general analysis of perfectly competitive selection markets that builds on the classical theory of a natural monopoly regulated to charge a price equal to average cost (Dupuit, 1849; Hotelling, 1938).[1] While this work has been influential, a constraint in applying the framework more broadly is that the assumption of perfect competition is questionable in many important selection markets. Perhaps because of this, existing work on imperfect competition has relied more heavily on structural assumptions about firm and consumer behavior (e.g., Starc, 2014). To provide a less parametric treatment, we extend the price-theoretic approach of Einav and Finkelstein, conveying our results whenever possible with simple graphs and verbal descriptions, with formal mathematical statements and proofs presented in an online appendix that accompanies that paper and is the appendix we refer to throughout this paper.[2]

The remainder of the paper proceeds as follows. Section II presents the model, and section III presents the main results. Section IV presents our applications to the HMG, health insurance, and consumer lending. Section V concludes.

II. Model

In this section, we describe a model of symmetric imperfect competition, that nests monopoly, perfect competition, and common models of imperfect competition including Cournot and differentiated products Bertrand competition. By placing these models in a common framework, we are able to develop results that are robust to the details of the industrial organization. Our model combines the model of selection markets proposed by Einav, Finkelstein, and Cullen (2010, henceforth EFC) and Einav and Finkelstein (2011, henceforth EF) with the model of imperfect competition proposed by Weyl and Fabinger (2013, henceforth WF), with suitable modifications to each to accommodate the features of the other.

[1] This is an application of Marshall's (1890) observation that competitive industries with economies or diseconomies of scale that are external to an individual firm's production would operate identically to a monopolist regulated to charge a price of average cost.

[2] See Weyl (2015) for a detailed discussion of price theory methodology more generally.

Consider an industry with symmetric firms that provide symmetric, though not necessarily identical, products.[3] When firms produce symmetric quantities, prices are given by $P(q)$, where $q \in [0, 1]$ denotes the fraction of consumers served by the market. We do not specify the cardinality of the firms in the market to minimize the notational burden. For most of our analysis, we assume, like EF, that individuals who do not purchase the product from the industry receive no product. However, as we discuss in some detail in section IIC, the outside option may in some cases be an alternative product, as EFC emphasized.

As in EF, total costs for the industry are summarized by the aggregate cost function $C(q)$, given by the linear aggregation of the cost of all individuals served and associated marginal and average cost functions $MC(q) \equiv C'(q)$ and $AC(q) \equiv {}^{C(q)}/_{q}$. These may be increasing or decreasing in aggregate quantity depending on whether selection is respectively "advantageous" or "adverse."[4]

We assume that firms have no internal economies or diseconomies of scale, and thus no fixed costs. At a symmetric equilibrium, firms supply segments of the market that are equivalent in terms of their distribution of costs and thus have average costs equal to $AC(q)$.

Industry profits are $qP(q) - C(q) = q\left[P(q) - AC(q)\right]$. A competitive equilibrium requires that firms earn zero profits and is characterized by $P(q) = AC(q)$. A monopolist or collusive cartel chooses q to maximize profit by equating marginal revenue to marginal cost:

$$P(q) + qP'(q) \equiv MR(q) = MC(q).$$

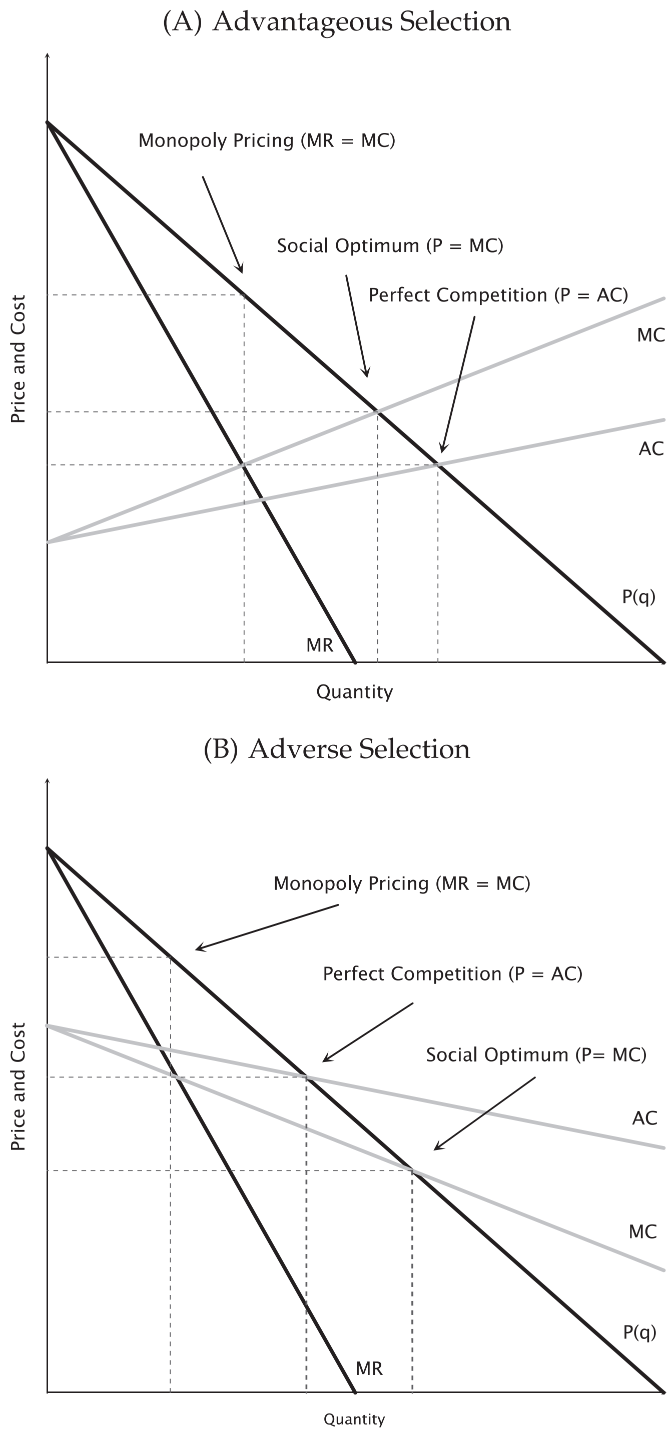
We also follow EF in assuming quasi-linear utility in price.[5] This allows us to define consumer surplus as $CS(q) = \int_0^q \left[P(x) - P(q)\right] dx$ and marginal consumer surplus as $MS(q) \equiv CS'(q) = -qP'(q)$. Social welfare is $CS(q) + qP(q) - C(q)$, and the first-order condition for the maximization of social welfare is

$$\begin{aligned} & -qP'(q) + qP'(q) + P(q) - MC(q) = 0 \\ & \iff P(q) = MC(q). \end{aligned}$$

Thus, the socially optimal quantity (constrained as we are throughout the paper to uniform prices) is characterized by $P(q) = MC(q)$.

Panel A of figure 1 shows the perfectly competitive equilibrium and monopoly and social optima in the case of advantageous selection where $AC'(q) > 0$ and the consumers with the highest willingness to pay are least costly.

FIGURE 1.—EQUILIBRIUM UNDER ADVANTAGEOUS AND ADVERSE SELECTION



This figure shows the perfectly competitive equilibrium and monopoly and social optima. (A) Equilibria in the case of advantageous selection where average costs are upward sloping. (B) Equilibria in the case of adverse selection where average costs slope downward.

Panel B shows the same in the case of adverse selection where $AC'(q) < 0$ and the consumers with the highest willingness to pay are most costly.[6]

[3] Some consumers may favor one product over another, but there must be an equal number of consumers who have the symmetric opposite preference.

[4] It is possible that these slopes have different signs over different ranges or that the two have slopes of different signs over a particular range. All of these cases do not fall cleanly into one category or the other and are not our focus in what follows. It would be interesting to extend our analysis to such cases.

[5] This assumption is literally valid, for instance, in the insurance application if individuals have constant absolute risk aversion (CARA) preferences and is an accurate approximation in most cases over the range of policy changes we consider (Willig, 1976).

[6] We follow EF in defining the sign of selection in terms of the slope of the average cost curve as this determines the sign of the marginal distortion under perfect competition as $AC'(q) = {}^{[MC(q) - AC(q)]}/_{q}$.

A. *Imperfect Competition* (θ)

We can nest the monopoly optimization and competitive equilibrium conditions into a common framework by introducing a parameter $\theta \in [0, 1]$. The parameter indexes the degree of competition in the market with $\theta = 0$ under perfect competition and $\theta = 1$ under monopoly. Equilibrium prices are given by

$$P(q) = \theta\left[MS(q) + MC(q)\right] + (1 - \theta)AC(q). \quad (1)$$

Below we discuss how equation (1) is a reduced-form representation of two canonical models of imperfect competition (formal derivations of these representations appear in appendix A):

1. *Cournot.* There are n symmetric firms that each choose a quantity $q_i > 0$, taking the quantity chosen by other firms as given. Price is set by Walrasian auction to clear the market so that the price is $P(q)$ where $q = \sum_i q_i$. If we assume that each firm gets a random sample of all consumers who purchase the product, then the equilibrium is characterized by equation (1) with $\theta \equiv 1/n$. Intuitively, just as in the standard Cournot model, firms internalize their impacts on aggregate market conditions proportional to their market share ($1/n$ at equilibrium) and otherwise act as price and average cost takers. This model can easily be extended to incorporate conjectural variations as in Bresnahan (1989; see WF for details).
2. *Differentiated product Bertrand.* There are n single-product firms selling symmetrically differentiated products. Each firm chooses a price p_i taking as given the prices of all other firms. Consumers have a type that determines their utility for each product and their cost. The distribution of consumer types is symmetric in the interchange of any two products. In addition to these traditional assumptions of the symmetrically differentiated Bertrand model, we add two assumptions proposed by White and Weyl (2016) that imply our representation is valid. First, the distribution of costs is orthogonal to the distribution of preferences across products given the highest utility a consumer can earn from any product. Second, the distribution of utility among the switching consumers that definitely will buy one product but are indifferent between any two products is identical to that among the set of all consumers who are currently purchasing a product. These two assumptions imply that the average cost of consumers who switch between firms in response to a small price change is the same as the average cost among all participating consumers.[7] In appendix A we provide two microfoundations for these assumptions based on standard models in the literature.

[7] Even if this assumption fails, so long as average switching consumers have a cost that is strictly between that of average exiting consumers and average purchasing consumers, most of our results are left unchanged.

In this case, again, our representation is valid if $\theta \equiv 1 - D$ where

$$D \equiv -\frac{\sum_{j \neq i} \partial Q_i/\partial p_j}{\partial Q_i/\partial p_i}$$

is the aggregate diversion ratio, which, by symmetry, is independent of the i chosen at symmetric prices. Note that unlike in the previous case, θ will not be constant in this case; it will typically increase in price and thus decline in quantity (WF).

B. *Selection* (σ)

We model a change in the degree of selection as a rotation of the industry average costs curve, because a completely flat average cost curve corresponds to a complete absence of selection. For this rotation to imply a ceteris paribus change in selection, it should leave some point on the average cost curve fixed. One possibility is to hold fixed average cost at the equilibrium quantity. However, under perfect competition, this rotation would leave price invariant to the degree of selection, in contrast to common intuition (Hendren, 2013). Moreover, a rotation around any point other than $AC(1)$ would increase or decrease average population cost, a counterfactual that strikes us as conceptually separable from a change in the degree of selection. We therefore parameterize selection as a rotation of the industry average cost curve holding population average costs, $AC(1)$, constant.

We operationalize this concept by adding a parameter σ that indexes the degree of selection, with $\sigma = 0$ representing a situation in which costs are mean independent of willingness to pay across individuals with ($AC(q) = MC(q) = AC(1)$) and $\sigma = 1$ normalized to represent the maximal degree of selection we allow in the model.

This parameterization maps to the type of regression approach to estimating selection in the empirical literature. Building on Chiappori and Salanié (2000), a growing literature estimates the correlation between demand and marginal costs in a range of selection markets (e.g., Finkelstein & Poterba, 2004; Bundorf, Levin, & Mahoney, 2012). Consider a standard econometric model of product choice:

$$v = \widetilde{\beta}_0 + \widetilde{\beta}_1(c - \mu_c) + \epsilon.$$

Here willingness-to-pay v depends linearly on expected costs c, which are distributed normally in the population $c \sim \mathcal{N}(\mu_c, V_c)$, and a mean-zero idiosyncratic taste parameter ϵ, which is independent of costs and normally distributed $\epsilon \sim \mathcal{N}\left(0, V_v - \widetilde{\beta}_1^2 V_c\right)$. In this formulation, we parameterize the variance of v with V_v rather than parameterizing the variance of ϵ, so that the correlation between c and v may be adjusted holding fixed the marginal distribution of v. Similarly, we normalize $\widetilde{\beta}_0$ and $\widetilde{\beta}_1$ so that changing $\widetilde{\beta}_1$ does not affect the mean of the marginal distribution of v.

In appendix A we use standard calculations for the normal distribution to show that if we define $\sigma \equiv \left|\widetilde{\beta}_1\right| \sqrt{V_c/V_v}$, $MC(q) \equiv \sqrt{V_c}\Phi^{-1}(1 - q) \pm \mu_c$ and

$$AC(q) \equiv \sqrt{V_c}\frac{e^{-\frac{\left[\Phi^{-1}(1-q)\right]^2}{2}}}{\sqrt{2\pi}q} \pm \mu_c,$$

we can write equilibrium conditions by replacing average costs with $\sigma AC(q) + (1-\sigma)AC(1)$ and marginal costs with $\sigma MC(q) + (1-\sigma)AC(1)$ in equation (1). Collecting terms, this yields

$$P(q) = \theta MS(q) + \sigma\Big[\theta MC(q) + (1-\theta)AC(q)\Big] + (1-\sigma)AC(1). \quad (2)$$

Thus, we have a representation of the first-order equilibrium condition where θ indexes the degree of market power and σ indexes the degree of selection in the market.

This linear interpolation between $AC(1)$ and $AC(q)$ or $MC(q)$ obviously relies on the joint normal structure of the example above. Another structure that yields the same results is if a fraction σ of the population is drawn from some arbitrary joint distribution of cost and willingness to pay while a fraction $1-\sigma$ is drawn from the same marginal distributions of cost and willingness to pay but with the two independently distributed of one another. More generally, reductions in parameterizations of the dependence (i.e., correlation) between cost and willingness to pay, holding fixed population average cost, often bring $AC(q)$ and $MC(q)$ toward $AC(1)$ at each point, though not necessarily linearly or proportionally. Given that all of the results in the next section depend only on this property of moving toward $AC(1)$ at each point, and not on the linear structure, our results apply more generally than these examples.

Nonetheless, we maintain this linear form in what follows for both expositional simplicity and because it conveniently represents one of the most common policies used to correct the effects of selection: risk adjustment. Medicare Advantage is a high-profile example. In the United States, elderly individuals with government health insurance can choose to opt out of the public Traditional Medicare (TM) program and purchase a private Medicare Advantage (MA) plan. For each enrollee, MA plans receive a payment from the government that is supposed to equal average costs under TM, partially risk adjusted to account for demographics and existing health conditions.

We can use our framework with one additional modification to model changes in the degree of risk adjustment in this and other similar settings.[8] Let $1-\sigma$ indicate the fraction of the difference between expected average and population average costs that is compensated for by risk adjustment. The average risk adjustment payments in this setting are $ARA(q) \equiv (1-\sigma)\left[AC(q) - AC(1)\right]$ with $\sigma = 0$ indicating a setting where firms are fully compensated for any differential selection they receive and $\sigma = 1$ indicating a setting where firms receive no risk adjustment. Firms' perceived average costs are the difference between their actual average costs and the average risk adjustment payments:

$$\widehat{AC}(q) = AC(q) - ARA(q) = \sigma AC(q) + (1-\sigma)AC(1).$$

Perceived industry marginal costs, as before, are the weighted average of marginal cost and $AC(1)$:

$$\widehat{MC}(q) = \sigma MC(q) + (1-\sigma)AC(1).$$

The effects of risk adjustment on equilibrium price and quantity—and thus consumer and producer surplus—will be the same as a change in σ due to different correlations. However, the effect on social surplus will differ because implementing risk adjustment in this manner is not budget neutral. To reduce the degree of adverse (advantageous) selection, an exchange operator needs to make net payments to (recover net payments from) insurance plans and will therefore run a deficit (surplus). As a result, social surplus depends only on whether quantity moves toward the socially optimal level under the original, non-risk-adjusted demand and cost curves.

C. *Interpretation of the Outside Option*

Thus far we have focused on the case where a consumer who does not purchase from the industry receives no product. Much of the literature considers a more general case when consumers choose between two products of different quality levels and must choose one of the two. This has been formulated in several ways, some of which fit our model and others which do not.

The first interpretation, by EFC, views the product in the market as the incremental quality of a high-quality product, such as supplemental insurance coverage to top up a low-quality base plan. This model is fully equivalent to ours from a positive perspective. It is also equivalent from a normative perspective so long as there are no externalities from the purchase of incremental quality on the cost of providing the low-quality base product.[9] A second, closely related setting is when consumers choose between a high-quality product supplied according to our model and low-quality, base product provided at a fixed, administratively set price (often 0). We use this approach in our application to employer-sponsored health insurance in section IVB. Our model corresponds to this case if suppliers receive from the low-quality provider baseline risk adjustment to account for consumers' cost of service under the baseline plan. This

[8] For instance, Handel, Kolstad, and Spinnewijn (2015) take an identical approach to modeling risk adjustment in their stylized model of an employer-sponsored health insurance market.

[9] Such externalities could be caused by moral hazard in an insurance setting or by common-pool problems in a credit setting. For instance, Medigap supplemental insurance, which provides incremental insurance for the deductibles and coinsurance in the baseline Traditional Medicare, blunts patients' incentives to control utilization, thereby imposing an externality on baseline insurance provider (Cabral & Mahoney, 2014).

ensures that the low-quality provider is indifferent to how many customers she retains and allows for an exclusive focus on the market for the high-quality product.

To see what this baseline risk adjustment means, consider an example where costs under the low-quality baseline health insurance plan are the high-quality costs scaled down by $\lambda < 1$, as would occur with a linear actuarial rate in the absence of moral hazard. Let $\widetilde{P}(q)$ and $\widetilde{AC}(q)$ be the high-quality plan's price and average costs. Letting P_0 be the administratively set price of the low-quality plan, the relevant price from the perspective of our model is $P = \widetilde{P} - P_0$, the net price for the high-quality plan. Similarly, when $\lambda\widetilde{AC}(q)$ is the baseline risk adjustment payment, the relevant average cost is

$$AC(q) = \widetilde{AC}(q) - \lambda\widetilde{AC}(q) = (1 - \lambda)\widetilde{AC}(q),$$

which is the average cost net of baseline risk adjustment.

Of course, baseline risk adjustment, which corresponds to $\sigma = 1$, is only one of many policies an employer or other risk adjuster might decide to pursue. A risk adjuster could, for example, make payments to fully account for costs under the high-quality plan or provide a flat subsidy and not risk-adjust at all. Risk adjustment to fully cover costs under the high-quality plan would correspond to a subsidy of

$$\begin{aligned}&\lambda\widetilde{AC}(q) + (1 - \lambda)\left[\widetilde{AC}(q) - \widetilde{AC}(1)\right]\\&\quad = \text{Baseline risk adjustment} + \left[AC(q) - AC(1)\right],\end{aligned}$$

which is full risk adjustment ($\sigma = 0$) in our model. Providing a flat subsidy equal to the population average cost would correspond to

$$\begin{aligned}\lambda\widetilde{AC}(1) &= \lambda\widetilde{AC}(q) + \left[\lambda\widetilde{AC}(1) - \widetilde{AC}(q)\right]\\&= \text{Baseline risk adjustment}\\&\quad - \frac{\lambda}{1-\lambda}\left[AC(q) - AC(1)\right].\end{aligned}$$

This can be thought of as negative risk adjustment in our model of an amount $\lambda/(1-\lambda)$ or $\sigma = 1 + \lambda/(1-\lambda) = 1/(1-\lambda) > 1$.

A final approach, adopted by Cutler and Reber (1998) and Handel et al. (2015), is to allow both the prices of the high-quality and baseline product to be endogenous. Extending this approach to imperfect competition is more analytically challenging, as it would require either an asymmetric treatment of the two plans or an equilibrium model where both plans are imperfectly competitively supplied. Such a model is an interesting direction for future research but sufficiently different from our analysis here that we view it as beyond the scope of our work.[10]

[10] See Weyl and Veiga (2017) for a more detailed discussion of the relationship among these models under perfect competition.

D. Technical Notes

In the next section, we study equilibria characterized by equation (2). To ensure a unique equilibrium exists, we impose global stability conditions that, while not necessary for our results, simplify the analysis. In particular, we assume that $P' < \min\{AC', MC', 0\}$ and $MR' < \min\{MC', 0\}$. Under these conditions, there is a unique equilibrium for a constant value of θ, the case we focus on below. While θ is not constant in the Bertrand case, all of our results can be extended to the case of nonconstant θ with appropriately generalized stability conditions at the cost of some notational complexity.

III. Results

In this section, we present results on the welfare effects of market power in industries with selection, and conversely, selection in industries with market power. To do so, we build on the notation, equilibrium, and stability conditions of the previous section. To ease the exposition, all propositions are stated verbally. When possible, the results are illustrated graphically assuming linear demand and costs, and often focusing on the extreme cases of monopoly and perfect competition. Formal statements and proofs of all results appear in Appendix B.

A. Imperfect Competition

Proposition 1. *Market power increases producer surplus and decreases consumer surplus.*

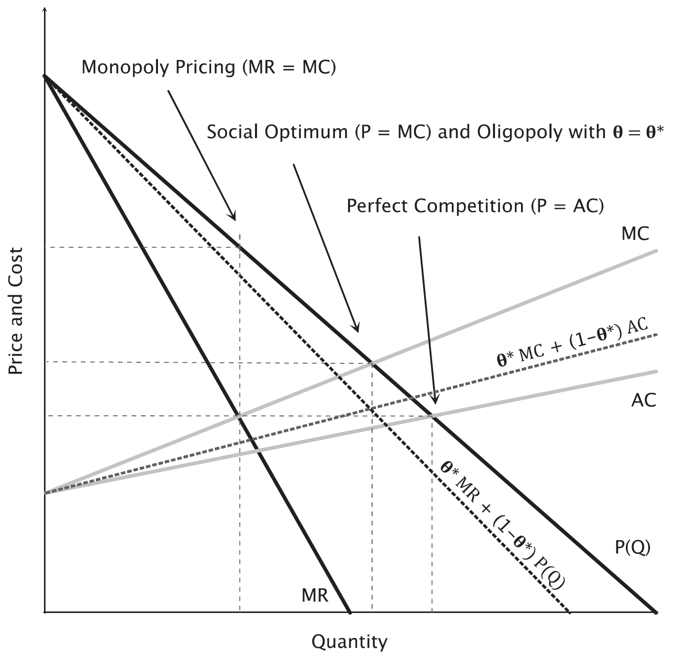
As firms gain market power, they increasingly internalize the impact of their output decisions on equilibrium price and quantity. This leads them to raise their price so long as price slopes downward more quickly than does average cost ($AC' > P'$), as implied by our stability assumptions. This internalization directly leads to higher producer surplus. The resulting higher price reduces consumer surplus by the logic of the envelope condition.

Proposition 2. *Under adverse selection, social surplus falls with market power. Any time a market would collapse as a result of adverse selection, no monopolist would choose to operate.*

With perfect competition, adverse selection leads to too little equilibrium quantity, as shown in Figure 1B. Since market power reduces quantity, market power only further reduces social surplus. An implication is that if the market collapses under perfect competition (Akerlof, 1970), and therefore the market generates no social surplus, no amount of market power will restore the market and enable it to contribute to aggregate welfare (Dupuit, 1844).

Under advantageous selection, our analysis more directly contradicts conventional intuitions on the impact of market power.

FIGURE 2.—OPTIMAL MARKET POWER UNDER ADVANTAGEOUS SELECTION



This figure shows that under advantageous selection, there is a socially optimal degree of market power strictly between monopoly and perfect competition. The monopoly optimum ($MR = MC$) results in too little quantity, while perfect competition ($P = AC$) results in too much. There is an intermediate level of market power θ^*, leading to an equilibrium, $\theta^* MR + (1 - \theta^*)P = \theta^* MC + (1 - \theta^*)AC$, that results in the same equilibrium level of quantity as the socially optimum ($P = MC$).

Proposition 3. *Under advantageous selection, there is a socially optimal degree of market power strictly between monopoly and perfect competition, and social surplus is inverse-U-shaped in market power. The optimal degree of market power is increasing in the degree of advantageous selection.*

Perfect competition leads to excessive output under advantageous selection because, in an attempt to skim the cream from their rivals, competitive firms draw higher-marginal-cost consumers into the market (de Meza & Webb, 1987). A monopolist, who internalizes the industry cost and revenue curves, will produce too little. As a result, there is an intermediate degree of market power that leads to the optimal quantity being produced.

Figure 2 shows this result graphically. The monopoly equilibrium, determined by $MR = MC$, results in too little quantity. The perfectly competitive equilibrium, determined by $P = AC$, results in too much. An intermediate level of market power $\theta = \theta^*$, which leads to the equilibrium determined by $\theta^* MR + (1 - \theta^*)P = \theta^* MC + (1 - \theta^*)AC$, results in the same equilibrium level of quantity as the equilibrium achieved by setting $P = MC$ and is therefore socially optimal. Because advantageous selection always pushes firms toward excessive production, the degree of market power required to offset this selection and restore optimality increases with the extent of advantageous selection.

Appendix table A1 summarizes our results, with panel A presenting the results on market power in selection markets.

B. Selection

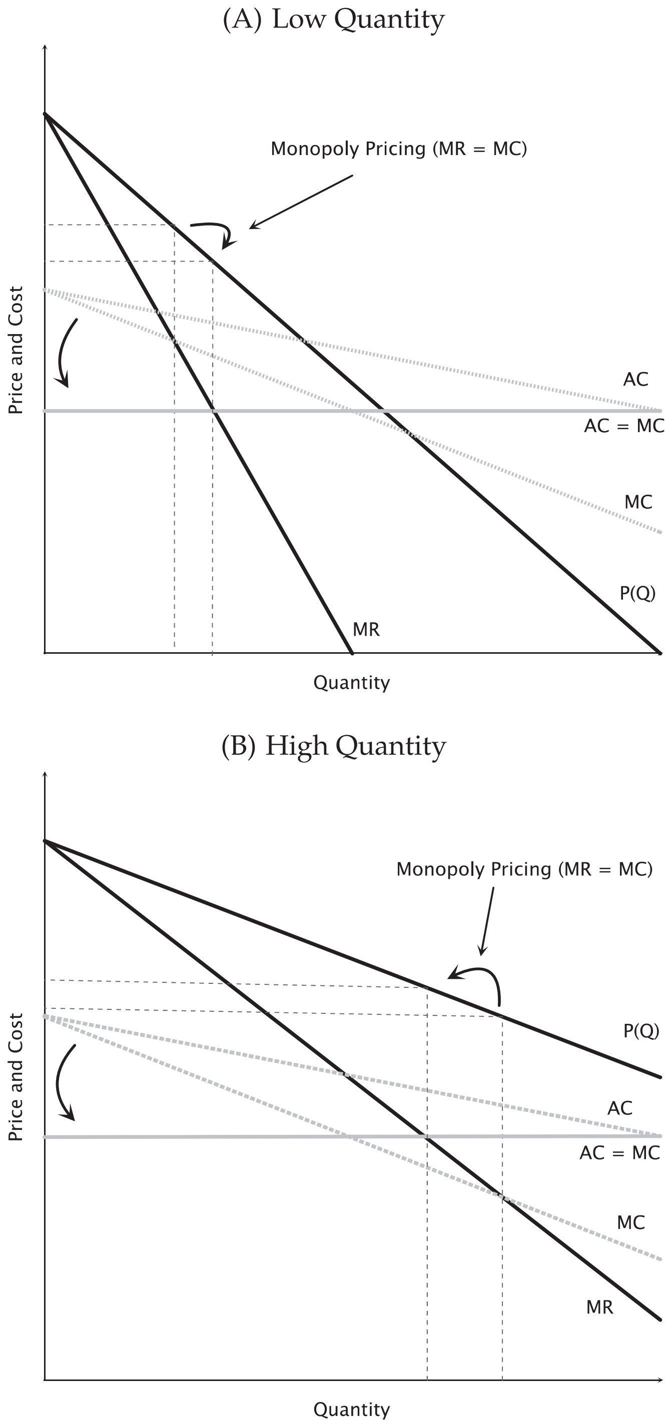
We begin our analysis of the effects of selection by considering the impact of changes on the degree of correlation between willingness to pay and cost. Because the degree of correlation is a property of a market, and not the result of a policy intervention, these results apply most directly to comparative statics across markets rather than the impacts of policy interventions. Our results are easiest to state verbally for the cases of monopoly and perfect competition. We thus confine our attention to these extreme cases. Results for intermediate cases are an interpolation between these extremes and are stated and proved in the formalization of these propositions in Appendix B.

Proposition 4. *Under monopoly, reducing the degree of adverse selection raises profits but can raise or lower consumer surplus. Less adverse selection harms consumers when demand is high ($q^\star > \underline{q}$). If demand is very high ($q^\star > \overline{q} > \underline{q}$) and the monopolist's pass-through is bounded away from 0, less adverse selection lowers both consumer and social surplus.*

Figure 3 shows the effect of reducing the degree of adverse selection in the market. Panel A shows the effect of this shift when the equilibrium quantity is low ($q^* < \underline{q}$), and panel B shows the effect when the profit-maximizing quantity is high ($q^* > \underline{q}$). When the equilibrium quantity is low, the reduction in selection lowers the cost of the average marginal consumer. This lowers the price and raises equilibrium quantity. When the equilibrium quantity is high, the reduction in selection raises the cost of the average marginal consumer, raising the price and lowering equilibrium quantity. With linear costs curves, reducing the degree of selection raises quantity whenever the profit-maximizing quantity is less than $\underline{q} = 1/2$ because under this distribution, the mean and median coincide. More generally, reducing the degree of adverse selection reduces prices and increases quantity whenever the population-average consumer has a cost lower than the average marginal consumer at the profit-maximizing level of quantity.

By the envelope theorem, we can determine the effect of a reduction in adverse selection on a monopolist's profits holding fixed the quantity the monopolist optimally chooses. Because a reduction in selection lowers average costs, as those participating in the market are selected adversely, producer surplus is necessarily increased. A reduction in the degree of adverse selection can lower welfare if the reduction in consumer surplus is large enough to offset the increase in firm profits. This happens only when profit-maximizing quantity is sufficiently high because in this case, the increase in marginal cost is large and the change in

FIGURE 3.—REDUCING ADVERSE SELECTION UNDER MONOPOLY



This figure shows the effects of reducing the degree of adverse selection in a market served by a monopolist. (A) A setting where the equilibrium quantity is low and reducing adverse selection lowers price and raises quantity. (B) A setting where the equilibrium quantity is high and reducing adverse selection increases price and lowers quantity.

average cost is small, as the firm's average consumers are nearly representative of the whole population.[11]

[11] The weight placed on the former effect relative to the latter effect in welfare terms is the monopolist's pass-through rate, so it must be bounded away from 0 at high quantities for the result to hold.

When there is advantageous selection, the conditions under which a decrease in the degree of selection raises consumer surplus are reversed.

Proposition 5. *Under monopoly, reducing the degree of advantageous selection lowers a monopolist's profits but can raise or lower consumer surplus. Less advantageous selection benefits consumers when demand is high ($q^\star > \underline{q}$).*

We discuss the intuition and graphical illustration of this result in appendix B.

Proposition 6. *Under perfect competition, reducing the degree of adverse (advantageous) selection raises (lowers) consumer surplus and is socially beneficial (harmful).*

Under perfect competition, firms make no profits, and thus the effect of selection on welfare is driven entirely by consumer surplus or, equivalently, prices. If consumers are adversely selected, consumers are always more costly than the population average, and therefore reducing the degree of selection always lowers average costs and prices, making consumers and society better off. The reverse occurs with advantagous selection.

C. *Risk Adjustment*

We next consider the impact of risk adjustment, which has the same positive implications as changing correlations but different normative implications. We consider only adverse selection and the case of monopoly, leaving the other cases for appendix B.

Proposition 7. *Under monopoly and assuming demand is strictly log concave*[12] *and satisfies a weak regularity condition, using risk adjustment to eliminate adverse selection has effects that are defined by the thresholds q' and $\underline{q} > q'$, where $\underline{q}$ is defined exactly as in proposition 4. The equilibrium quantity $q^\star$ is defined as its value after risk adjustment:*

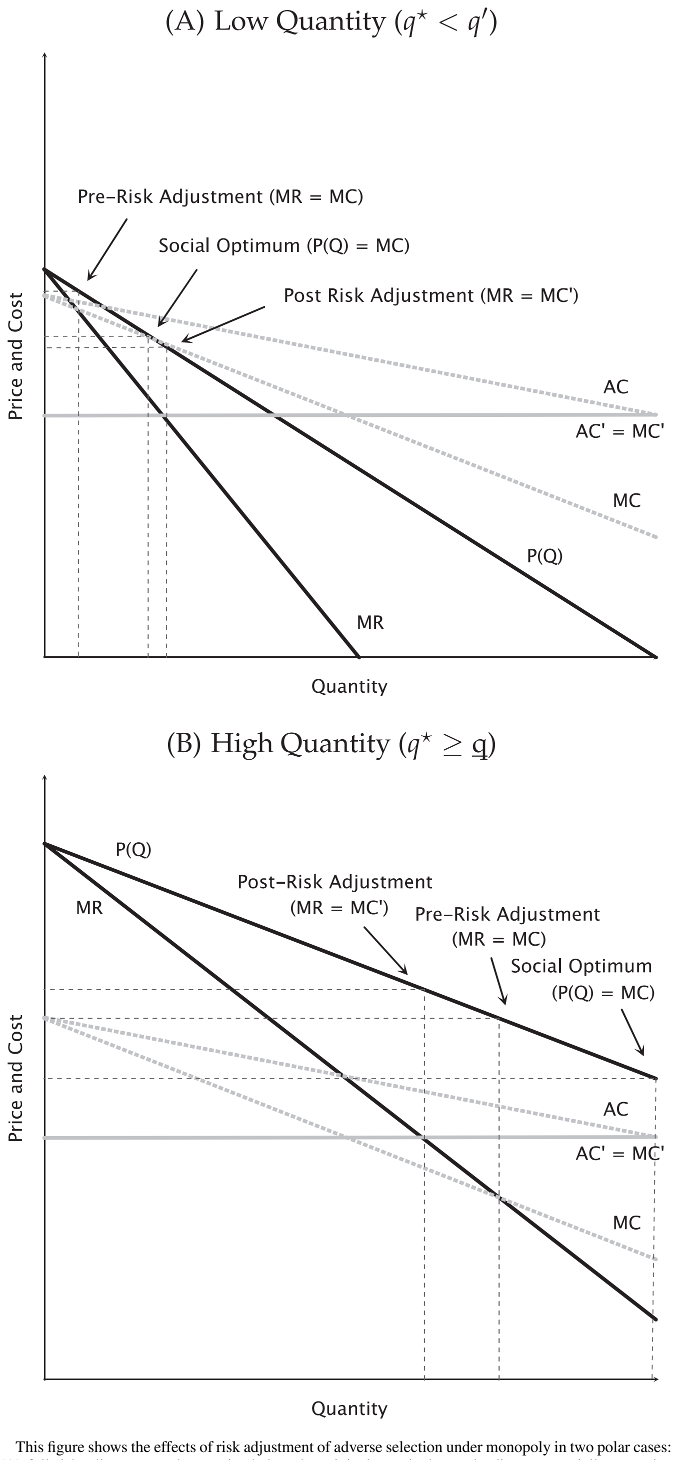
1. *If $q^\star < q'$, then there is an interior optimal quantity of risk adjustment.*
2. *If $q' \leq q^\star < \underline{q}$, then welfare is monotonically increasing in risk adjustment.*
3. *If $q^\star \geq \underline{q}$, then risk adjustment is harmful.*

Figure 4 graphically depicts these results for the different quantity ranges. Social surplus depends on whether quantity is moved toward the socially optimal level under the original, non-risk-adjusted demand and cost curves. Since monopoly results in too little quantity, risk adjustment that increases quantity is beneficial so long as it does not increase quantity beyond the socially optimal level.

Panel A shows a setting where $q^\star < q'$. In this case, risk adjustment is initially beneficial, but full risk adjustment

[12] In appendix B, we treat the case when demand is not log concave.

FIGURE 4.—RISK ADJUSTMENT OF ADVERSE SELECTION UNDER MONOPOLY



This figure shows the effects of risk adjustment of adverse selection under monopoly in two polar cases: (A) full risk adjustment reduces price below the original marginal cost, leading to a socially excessive quantity; (B) risk adjustment raises marginal costs perceived by the firm, lowering quantity and social welfare.

reduces price below the original marginal cost, leading to socially excess quantity. Intuitively, this occurs at low quantity because this is where (under log concavity) the monopoly distortion $MS(q^*)$ is the smallest and risk adjustment has the biggest effect on reducing perceived marginal costs. We omit the intermediate case when welfare monotonically increases in risk adjustement. Panel B depicts the more surprising case where $q^\star \geq \underline{q}$, and risk adjustment raises marginal costs perceived by the firm, lowering quantity and thereby reducing social welfare.

D. *Other Forces Affecting Selection*

Correlation and risk adjustment are only two of many forces that have an impact on the extent of selection. Other commonly discussed factors are changes in consumers' knowledge of their own costs (Handel & Kolstad, 2015) and changes in the permitted extent of risk-based pricing (Finkelstein & Poterba, 2006). These interventions will not only result in a change in the cost curves but will also shift the demand curves. In the first case, this is because greater knowledge by consumers of their health risks will shift the distribution of willingness to pay for insurance. In the second case, characteristics that are used to price risk can also be used to price-discriminate. Because accounting for such effects requires a different analytical approach from the one we adopt here, we do not treat these forces generally. Instead, we consider specific examples that illustrate possible and plausible cases. First, in appendix C, we show that the discrimination allowed by risk-based pricing can offset or even reverse the results we derived above about the effects of selection under market power. Second, in section IVB, we use our calibrated model of the insurance market to study the impact of these changes.

IV. Applications

A. *Merger Analysis*

In this section, we examine central principles articulated in the most recent revision of the U.S. Horizontal Merger Guidelines (U.S. Department of Justice and Federal Trade Commission, 2010) and show that many qualitative findings are altered or reversed in an industry with selection. To simplify the analysis, we focus on a symmetrically differentiated Bertrand industry in which a potential merger changes the industry from a duopoly to a monopoly:

1. *Price-raising incentives are harmful.* A basic principle of merger analysis is that the stronger are firms' incentives to raise prices as a result of a merger, the more antitrust authorities should suspect the merger. However, to the extent that the incentive to raise prices is stronger because of selection, mergers are likely to be more beneficial the stronger the incentive to raise prices.

   Consider the first-order incentive of a firm to raise prices after a merger (Farrell & Shapiro, 2010; Jaffe & Weyl, 2013), or upward pricing pressure (UPP), measured by the externality a firm imposes on its rivals when it increases its sales by 1 (infinitesimal) unit. When a firm increases its sales by 1 unit, it diverts

D units from its rivals. Absent selection, the markup associated with this unit is $M = P - MC$ so that the sale exerts a negative externality on its rivals of $DM = D(P - MC)$.

In a selection market, it can easily be shown (see appendix D) that naively calculating this quantity using the firm's perceived marginal cost does not capture the externality imposed by a firm on its rivals because the consumers who are unilaterally marginal for one of the firm's are not the same ones that are diverted from a rival. Instead, our assumption that switching consumers are representative of all consumers and have costs given by AC means that the incremental profit from this unit is $P - \sigma AC - (1 - \sigma)AC(1)$ and the sale creates a negative externality on rivals of $D[P - \sigma AC - (1 - \sigma)AC(1)]$. As a result, in appendix D, we show that

$$\text{UPP in selection markets} = \text{Standard UPP} + \sigma D(1 - D)(MC - AC),$$

where standard UPP is calculated using the firm's unilaterally perceived marginal cost.

This formula states that advantageous selection (larger σ when $MC > AC$) creates more upward pricing pressure. Yet this is precisely the setting where market power can be a desirable check on cream-skimming externalities. Conversely, greater adverse selection (raising σ when $MC < AC$) reduces upward pricing pressure, but at the same time, it is the setting where market power is most harmful because it further distorts the incentive to price above marginal cost. Thus, to the extent that it is selection rather than changes in D or M that generates upward pricing pressure, a merger is actually most desirable when pricing pressure is large rather than small. For the rest of this section, we assume $\sigma = 1$.

2. *Competition reduction is harmful*. A second principle of merger analysis is that antitrust authorities suspect mergers where the goods are close substitutes (with large D) as this increases UPP, as highlighted above. However, under advantageous selection when welfare is inverse-U-shaped in θ, it is precisely when competition is very intense (low θ) that a market power–increasing merger may be beneficial. Recall that $D = 1 - \theta$. Thus, under advantageous selection, mergers may be socially beneficial (absent other efficiencies) if and only if D is large enough.
3. *Marginal costs should be used to calculate markups*. A third principle is that a firm's marginal, not average, cost should be used to assess UPP. However, in selection markets, recall that the valid UPP is $D(P - AC)$ and not $D(P - [DAC + (1 - D)MC])$. Thus, if we want to use the simple formula suggested by Farrell and Shapiro (2010) to calculate UPP, we should use average, not marginal, cost to calculate firms' markups.[13]
4. *Demand data are preferable to administrative data*. As a result of the focus on marginal costs, antitrust analysts often prefer demand-side data to administrative data (Nevo, 2001). Marginal costs are hard to measure from firm administrative data (Laffont & Tirole, 1986), so it is standard to measure marginal costs by estimating demand and using the firm's first-order condition to recover marginal costs using the approach of Rosse (1970). However, in markets with selection, the demand-driven approach identifies the markup over unilaterally perceived marginal cost and not the relevant markup over average cost needed to calculate $D(P - AC)$. Indeed, in selection markets, demand data are insufficient, and it is necessary to have administrative data that reveal P and AC to calculate valid UPP. This implies that the administrative data obtained in recent studies of selection markets (cf. Einav, Finkelstein, & Levin, 2010) are likely to be useful not only for the measurement of selection but also for antitrust policy.

In the discussion, we have considered only the price impact of a merger of a duopoly to monopoly as is common especially at the screening stage of standard merger reviews. Enriching our analysis (for example) to allow for endogenous changes in product characteristics would obviously complicate our specific results, but would actually reinforce our message that selection fundamentally changes the conclusions of standard merger analysis, as we discuss in Mahoney, Veiga, and Weyl (2014).

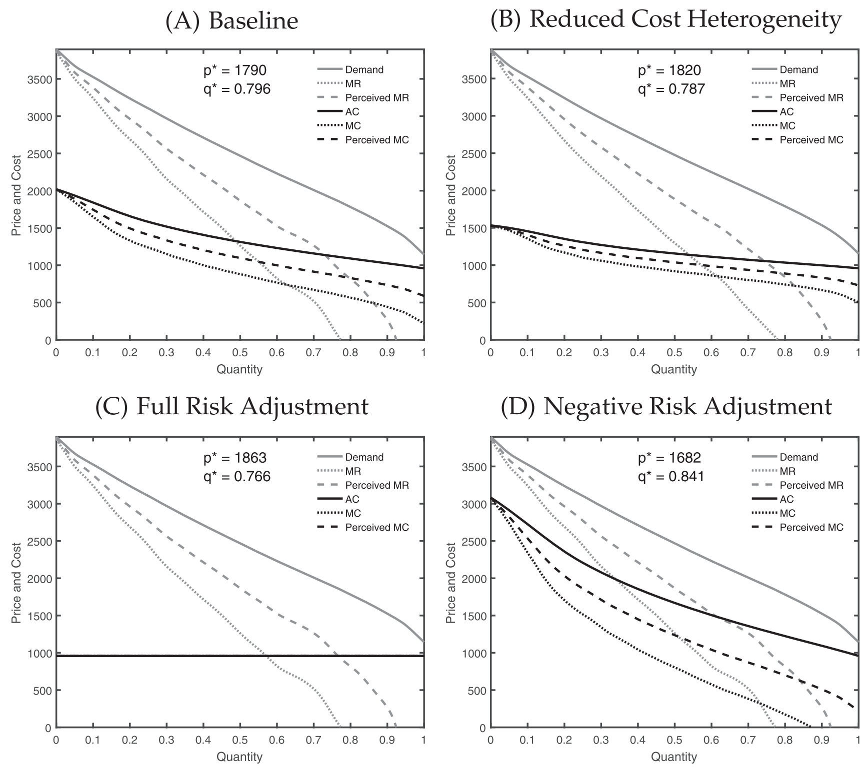
B. *Health Insurance*

In this section, we examine the quantitative importance of our predictions in a benchmark health insurance example. Our model is designed to approximate basic features of an employer-sponsored health insurance setting and is similar to the models used in much of the recent literature (e.g., Einav, Finkelstein, & Cullen, 2010; Handel, Hendel, & Whinston, 2015; Handel, et al., 2015; see appendix E for details).

A key decision for employers is how to set subsidies for the high-quality plans. Cutler and Reber (1998) argue that Harvard University's decision to provide a constant per employee subsidy led to an "adverse selection death spiral" and the collapse of the high-quality plan. They propose that subsidies be risk-adjusted to account for selection, and many employers, along with other health insurance exchanges,

[13] This result is partly an artifact of our assumption that firms have additive costs across consumers, which is analogous to firms having linear (i.e., constant marginal) costs in a standard market. Accounting for firm-level (dis)economies of scale from forces other than selection would require an adjusted notion of marginal cost. Nonetheless, even in this case, firm-level marginal costs would be inappropriate for predicting UPP. And if selection is the primary source of nonlinear cost, average cost will be more accurate in predicting UPP than the standard notion of marginal cost.

FIGURE 5.—REDUCED ADVERSE SELECTION IN HEALTH INSURANCE MODEL



This figure shows the effects of different amounts of adverse selection in the calibrated health insurance model. (A) The baseline equilibrium ($\sigma = 1$). (B) A scenario where the demand curve is unchanged but there is a lower correlation between willingness to pay and marginal costs. (C) An equilibrium with full risk adjustment so that marginal costs are constant in the population ($\sigma = 0$). (D) Negative risk adjustment of an equal and opposite amount to the full risk adjustment payments ($\sigma = 2$).

now implement risk adjustment schemes. However, Cutler and Reber's model, and other work that we are aware of on risk adjustment, assumes insurers are perfectly competitive, which contrasts with the findings of Dafny (2010) and Dafny et al. (2012) on limited competition in employer-sponsored health insurance.[14]

Figure 5 examines the effects of risk adjustment on premiums and allocations in our calibrated model. Panel A shows the equilibrium with baseline risk adjustment ($\sigma = 1$). Panel B shows the equilibrium from an alternative calibration where we keep the demand curve unchanged and reduce the variation of health type λ, holding constant population average costs under the insurance contract.[15] Because demand is the same and there is less variation in costs, this exercise implements the same reduction in the degree of correlation between willingness to pay and costs that we explored theoretically. Panel C shows the equilibrium where an exchange operator implements full risk adjustment ($\sigma = 0$) so that consumers have constant marginal costs equal to the population average. Panel D shows an equilibrium with partial negative risk adjustment; in particular, the exchange operator risk-adjusts subsidies by an equal and opposite amount to the full risk adjustment payments ($\sigma = 2$).[16]

With baseline risk adjustment, premiums are \$1,790, and 79.6% of the population purchases a high-quality plan. Because marginal costs are below average population costs at this equilibrium, reducing the degree of correlation increases the cost of the marginal consumer, raising premiums to \$1,820 and reducing quantity to 78.7%. Eliminating selection by means of perfect risk adjustment further raises the price and reduces the quality provided by the market. Negative risk adjustment reduces premiums to \$1,682 and raises quantity to 84.1%.

Table 1 examines the normative implications of these counterfactuals. All values are presented as a percentage of the first best total surplus under the baseline scenario. Under the baseline scenario, shown in the first column, imperfect competition and selection combine to reduce total surplus to 85.7% of the first best level. Producers capture slightly less than half of this surplus, while employees capture the remainder. By raising prices, reduced correlations, shown in

[14] Papers that assume perfect competition or a constant markup include Handel, Hendel, et al. (2015), Bundorf et al. (2012), Glazer and McGuire (2000), Pauly and Herring (2000), Feldman and Dowd (1982), and Carlin and Town (2009). In contrast, Dafny (2010) and Dafny et al. (2012) show that not only is the insurance sector highly concentrated but that recent mergers have significantly raised premiums in the large-employer segment of the market.

[15] Because of the nonlinearity of the insurance contract, holding constant population average costs under the insurance contracts requires us to adjust the mean population cost.

[16] Full negative risk adjustment ($\sigma = 3$) has even more extreme effects in the same direction, but violates our stability conditions and thereby creates some unnecessary expositional challenges.

TABLE 1.—WELFARE EFFECTS OF REDUCING ADVERSE SELECTION

	(1)	(2)	(3)	(4)	(5)
	Percent of First Best Total Surplus				
	Baseline	Reduced Cost Heterogeneity	Full Risk Adjustment	Negative Risk Adjustment	Segmented Market
Employee + employer surplus	49.6%	48.3%	37.1%	62.8%	32.1%
Employee surplus	49.6	48.3	45.9	55.4	32.1
Employer surplus	0.0	0.0	−8.9	7.4	0.0
Producer surplus	36.0	39.8	45.0	27.9	67.2
Total surplus	85.7	88.1	82.1	90.7	99.3

This table shows the welfare effects of reducing the degree of adverse selection in the calibrated health insurance model. Column 1 shows welfare under the baseline equilibrium ($\sigma = 1$). Column 2 shows welfare in a scenario where the demand curve is unchanged but there is a lower correlation between willingness to pay and marginal costs. Column 3 shows welfare with full risk adjustment ($\sigma = 0$). Column 4 shows negative risk adjustment of an amount equal and opposite in sign to full risk adjustment ($\sigma = 2$). Column 5 shows welfare when the market is segmented into four quartiles based on consumer health type λ. All values are presented as a percentage of the first best total surplus in the baseline scenario.

the second column, lower employee surplus by 1.4 percentage points of the total surplus at the social optimum. Profits increase by 3.7 percentage points due to the lower costs of providing coverage, more than offsetting the decline in employee surplus and raising total surplus provided by the market. These results are consistent with proposition 4 in the setting where optimal quantity takes a high, but not very high, value (i.e., $\overline{q} > q^\star > \underline{q}$).

Full risk adjustment, shown in column 3, exacerbates the effects of reducing correlations on employee surplus. Relative to the baseline scenario, full risk adjustment reduces employee surplus by 12.5 percentage points and increases profits by 9.0 percentage points of first best total surplus. Moreover, implementing full risk adjustment requires the employer to run a deficit equal to 8.9% of the optimized social surplus. Negative risk adjustment, shown in column 4, has the opposite effect, raising combined employee-employer surplus by 13.2 percentage points and reducing producer surplus by 8.1 percentage points relative to the baseline level. Thus, the calibrated results indicate that risk adjustment has the counterintuitive effect of reducing surplus for employees and surplus provided by the market, as described in proposition 7 in settings where the optimal quantity is high ($q^\star > \underline{q}$).

Segmenting the market, shown in column 5, not only allows prices to reflect cost differences across employees but also allows the insurance companies to price-discriminate by charging different markups to different market segments. It therefore does not correspond cleanly to our pure cost-side parameter σ. To implement segmentation, we partition the distribution of λ into quartiles and allow the firms to charge the profit-maximizing price to each market thus defined. Appendix figure A3 shows plots that depict equilibrium price and quantity in each segment.

We find that the segmented markets have essentially no selection (a more-or-less flat cost curve) so that the results under segmentation reflect the elimination of selection as well as any price discriminatory effects. Segmentation reduces employee surplus by 17.5% of the optimized total surplus, more than the decline under full risk adjustment. The reduced selection combined with the ability to price-discriminate raises profits by a substantial 31.2 percentage points of the optimized total surplus. Total surplus from the market is within 1 percentage point of first best level, but the incidence is significantly skewed, with producers capturing more than two-thirds of the surplus generated by the market. This suggests that employers' reluctance to adopt risk-based pricing may be due not only to legal restrictions and concerns about reclassification risk (Handel, Hendel, et al., 2015), but may also stem from the more familiar concern that allowing for price discrimination would transfer significant surplus from employees to insurance companies.

In appendix F, we also use the model to examine the effect of a change in correlations that would result from a change in consumer perceptions about the distribution of risk they face. For instance, an insurance choice decision aid might reduce misperceptions of costs and therefore increase the degree of selection in the market. Reducing the correlation between perceived and actual health risk has the effect of decreasing the degree of selection in the market, as shown in appendix figure A4. This means that similar to the results above, increased misperceptions raise price and reduce quantity in the market, even under the demand curves that result from perceived risk.[17] Employee surplus is even lower, and social surplus actually falls, under empirically observed (viz., fully biased) demand curves, since the misperceptions create an allocative inefficiency in who receives insurance coverage. This pushes against the argument Handel (2012) made that in a perfectly competitive environment, nudging (improving information) can hurt consumers by exacerbating the degree of selection. On the contrary, our result helps justify employer efforts to help employees optimize their health plan choice through engines provided by firms like Picwell.

These findings on risk adjustment and risk-based pricing are not universal. As discussed in section III, eliminating selection may raise or lower consumers and social surplus, and the same is famously true of the price discriminatory effects of market segmentation (Aguirre, Cowan, & Vickers, 2010). To examine the robustness of these conclusions, consider appendix figure A5. The vertical axis represents

[17] Increasing misperceptions raises producer surplus, suggesting that policy efforts to de-bias consumers through decision aids may be opposed by the insurance industry.

the degree of market power θ. The horizontal axis represents the equilibrium fraction of individuals served in the market. The dots show simulated markets constructed using data on the distribution of market power based on concentration indices reported by Dafny et al. (2012) and coverage rates in the EHBS.[18] The figure shows that a significant share of markets fall in the top-right region, where risk adjustment reduces social surplus by lowering quantity. Furthermore, most markets fall at least into the central region, where risk adjustment reduces combined employer-employee surplus. Our results are therefore fairly robust: Risk adjustment is, from the perspective of the firm and its workers, attractive in a relatively small part of the parameter space and in a minority of markets.

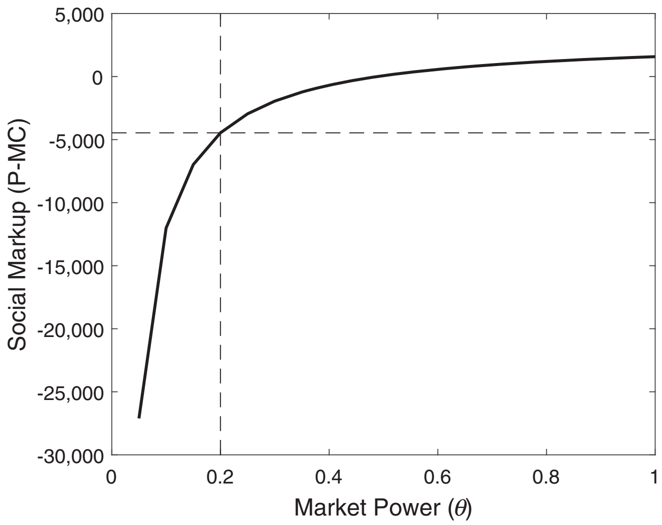
Our results should be taken with caution, however, because they depend heavily on our assumption that there are only two quality tiers in the market: high and baseline quality. Suppose instead that there were three quality tiers available, with very unhealthy individuals sorting into the highest-quality plan, intermediate-health individuals sorting into the medium-quality plan, and the healthiest individuals sorting into the baseline plan. It then seems likely that even the marginal customers of the highest-quality plan would be costlier than the population average, while the average marginal customers of the medium-quality plan would be a mix of the costly customers substituting from the high-quality plan and the low-cost customers substituting from the baseline plan. Risk adjustment would thus likely lower the price of the high-quality plan and leave fixed the price of the medium-quality plan and therefore might be beneficial in a fairly broad range of cases. Enriching our analysis to allow for such vertical differentiation in combination with market power is thus an important direction for future research.

C. Competition and Consumer Lending

We assess the potential for excess competition in consumer lending by using the Einav, Jenkins, and Levin (2012, henceforth EJL) model of subprime auto lending, which they calibrate to proprietary data from a large firm. We apply our framework to this setting by modeling the down payment as the "price" of the product, holding fixed the total size of the loan the consumer takes out and owes in the future. There is considerable advantageous selection in this market, with the marginal borrower with respect to the down payment defaulting 79% of the time relative to a default rate of 59% among average borrowers. (See appendix G for more details.)

We assess the potential for socially excess competition by calculating the social markup as a function of industry competition. The social markup is defined as the difference

FIGURE 6.—SOCIAL MARKUP



This figure shows the social markup $P - MC$ (y-axis) of the down payment on a $10,000 car loan as a function of the degree of market power (x-axis). The social markup on the down payment is defined as the difference between the required down payment amount and the cost for the marginal borrower, with a negative value indicating a subsidy to borrowers. The values are calibrated using the model and estimated parameters from Einav, Jenkins, et al.'s (2012) study of subprime auto lending.

between the equilibrium price and the social marginal cost for the marginal borrower:

$$\text{Social markup} = P - MC = \theta MS + (1-\theta)\left[AC - MC\right].$$

When the social markup is positive, there is too little equilibrium quantity, and social surplus is increasing as the market becomes more competitive. When the social markup is negative, there is too much equilibrium quantity, and greater market power would improve social welfare.

The parameters of the social markup function can be recovered from the estimates of demand and selection perceived by the firm, which, following the notation in section II, are indicated with a "hat." Because of our symmetry assumption, average costs for the industry are equal to those perceived by the firm: $AC = \widehat{AC}$. We can recover industry marginal costs for a given θ by rearranging the formula for perceived marginal costs to yield $MC = {}^{[\widehat{MC}-(1-\theta)AC]}/_{\theta}$.[19] We can similarly recover industry marginal surplus from perceived marginal surplus from the perspective of a single firm, $MS = ({}^{1}/_{\theta})\widehat{MS}$, where $\widehat{MS} = {}^{P}/_{\hat{\epsilon}}$ and ϵ is the absolute value of the lender's residual demand elasticity.

Figure 6 plots the social markup (y-axis) as a function of the market power parameter θ (x-axis).[20] The value $\theta = 0.2$ is a useful benchmark; with symmetric firms in Cournot competition, it corresponds to an HHI of 2,000, just above the threshold the Department of Justice used to define markets as highly concentrated during this period. For $\theta = 0.2$, the marginal borrower is subsidized by $4,462, or

[18] We use the reported HHI ratio to measure θ, which Cabral, Geruso, and Mahoney (2014) find is an accurate proxy in a related setting.

[19] The formula for perceived marginal costs is $\widehat{MC} = \theta MC + (1-\theta)AC$.

[20] We only consider variation in θ and not other parameters because, given our symmetry assumptions, all other parameters are identified by EJL's model.

41% of the price of the car. Indeed, the marginal borrower receives a subsidy for all $\theta < 0.5$, or symmetric Cournot duopoly, indicating that high levels of concentration may be desirable.

The exercise above restricts attention to a single dimension of competition. However, as EJL highlight, competition is potentially very multidimensional. To take the simplest example, there is no clear reason that down payments need to move in lockstep with the total price for the car and thus leave the debt burden fixed. Veiga and Weyl (2016) analyze the EJL data in a model allowing for endogenous multidimensional contract terms and find that our basic conclusion—that increased market power may be socially desirable—is actually reinforced by allowing for endogenous multidimensional contracts. Competition leads to cream skimming, distorting the nature of and not just the price of contracts. However, they find that in the EJL data, this would lead to excessively high, not excessively low, down payment requirements. Whether lending is overall too lax or too tight thus depends on whether the cream-skimming effect they emphasize or the advantageous selection effect we focus on is of greater magnitude. Their quantitative analysis suggests the latter, but a richer empirical equilibrium analysis would be necessary to precisely resolve this ambiguity.

Thus, as we discuss in greater detail in an accompanying policy piece (Mahoney et al., 2014), while our conclusion about the surprising potential social benefits of market power seems fairly robust, the implications for financial regulation should be approached with caution.

V. Conclusion

This paper makes three contributions. First, we propose a simple but general model nesting a variety of forms of imperfect competition in selection markets. Second, we derive from this model several basic yet often counterintuitive comparative statics. Third, we show the empirical and policy relevance of these comparative statics by applying them to merger policy and calibrated models of health insurance and subprime auto lending.

Our work here suggests several directions for future research. We have shown calibrated and empirical examples where the counterintuitive comparative statics we derived are relevant. However, it is not clear how prevalent such examples are or the extent to which the issues we raise are first order in determining optimal competition or selection policy. Further empirical research is required to investigate these questions. We have also focused on a small number of policy instruments: merger policy, risk adjustment, risk-based pricing, and consumer information campaigns. While these may be the most canonical policies for addressing selection and market power, many other policies, such as price controls and restraints on exclusive dealing, play an important role. Studying these policies in imperfectly competitive selection markets would be informative.

As we have repeatedly emphasized, a central limitation of our analysis is our assumption of symmetry across products and that nonprice product characteristics are exogenous. These together imply that uptake of the product varies only along the extensive margin. However, in many selection markets, such as insurance markets, the intensive margin is at least as important as the extensive margin, especially with the increasing prevalence of mandates for basic coverage. As a result, the literature on selection markets has increasingly turned to studying the quality of products offered (Veiga & Weyl, 2016; Azevedo & Gottlieb, 2017). While Veiga and Weyl (2016) analyze the impact of market power in detail, the richest work in this literature (Azevedo & Gottlieb, 2017) focuses on perfect competition. We hope future research will study more richly the interaction between market power and the intensive margin of product uptake.

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