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Does online third-degree price discrimination improve welfare?

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Abstract

In a recent article, Guo and Lai (2022) claim that online third-degree price discrimination improves welfare under certain conditions. I argue that, in the same model, the same results can be obtained even if there are only offline firms. Therefore, welfare improvements cannot be imputed to the existence of online competitors.

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1. Introduction

In a recent paper, Guo and Lai (2022) (GL henceforth) claim that online competition might improve welfare even in the absence of a total output increase. In particular, this happens when the intensity of online/offline competition is strong enough (that is, the online-offline cross-demand parameter is large). The policy implication of this claim is relevant: under certain circumstances, online competition should be encouraged as it increases welfare.

In this note I add to GL by pointing out that online competition is not necessarily the source of the welfare improvement in the GL framework. After substituting the online firms in the GL model with offline (or traditional) firms, I show that the results are completely unchanged. Hence, the same results can be obtained in the GL model with purely offline competition, thus implying that the existence of online firms is not necessary for third-degree price discrimination to increase welfare.

2. The model

I briefly illustrate the GL set-up (more details of the model can be found in the original article). There are two markets, 1 and 2. In each market, there is an offline or traditional firm: Firm 1 in market 1 and Firm 2 in market 2. Moreover, there is an online firm, Firm *O*, which is assumed to operate in both markets.

The utility function of the representative consumer is the following:

$$u_i = \frac{a_i(b+\gamma)(D_i+D_i^O)-(\frac{b}{2}D_i^2+\frac{b}{2}{D_i^O}^2+\gamma D_i D_i^O)}{b^2-\gamma^2} - \lambda D_i^O + y_i, \quad (1)$$

with $i = 1{,}2$ and where $\lambda > 0$ is the distaste cost in the case of an online purchase; it is zero in the case of offline purchase. Therefore, in the GL model, λ *captures the difference between online and offline firms*.[1] In other words, when $\lambda = 0$,

[1] For the meaning of the other parameters appearing in the utility function, see GL. There is another heterogeneity between Firm *O* and the offline rivals. Indeed, GL assume that the offline firms sustain marginal costs equal to *c*>0, whereas Firm *O* has no costs. However, parameter *c* plays no role for the results in GL, so I disregard it by setting *c*=0 for all the firms.

there is no difference between Firm O and Firm $i = 1,2$, which is the same to say that all firms are offline. I shall turn later on this point. From (1), the direct demand functions are immediately obtained:

$$D_i^O = a_i - b\left(p_i^O + \lambda\right) + \gamma p_i \text{ and } D_i = a_i - bp_i + \gamma\left(p_i^O + \lambda\right) \quad (2)$$

Given these demand functions, the model is solved both when the online firm is allowed to price discriminate (that is, it can set different prices for market 1 and market 2), and when it is not. Then, comparative statics in terms of total output, consumer surplus, profits, and welfare are easily derived (see GL for details).

In particular, Proposition 1 in GL claims that total welfare is higher when *online* third-degree price discrimination is allowed if and only if $\gamma > 2(\sqrt{2} - 1)b$. Thus, GL conclude that *online third-degree price discrimination is welfare improving* when $\frac{\gamma}{b}$ is high enough.

In what follows, I add to GL by showing that online competition is not necessary for third-degree price discrimination to be welfare improving.

First, it can be observed that the result above (as well as all the other results in GL) does not depend on λ, which is the parameter capturing the online/offline heterogeneity of the model. In other words, the irrelevance of λ seems to suggest that the same results could be obtained in a model of purely *offline* third-degree price discrimination.

In what follows, I rebuilt the GL model without considering an online firm, and I show that the same results of GL are obtained.

Suppose having three offline or traditional firms: Firm 1 operates in market 1, Firm 2 operates in market 2, and Firm T operates in both markets. For instance, Firm 1 and 2 are local firms, whereas Firm T is a multimarket or multinational firm operating in several places. Since the three firms are identical (no one is an online firm), I simply set $\lambda = 0$ (see the discussion above). The demand functions are still given by (2).

When Firm T cannot price discriminate across the two markets (uniform pricing), the equilibrium prices are:

$$\bar{p}_i^T = \frac{a_1+a_2}{2(2b-\gamma)} \text{ and } \bar{p}_i = \frac{4a_i b-\gamma(a_i-a_{-i})}{4b(2b-\gamma)} \quad (3)$$

When Firm T can price discriminate, the equilibrium prices are:

$$p_i^T = p_i = \frac{a_i}{2b-\gamma} \quad (4)$$

Since the total welfare is given by $u_1 + u_2$, when there is no price discrimination I obtain:

$$\bar{W} = \frac{(a_1^2+a_2^2)(52b^3-40b^2\gamma+3b\gamma^2+\gamma^3)-2a_1a_2(4b^3-8b^2\gamma+3b\gamma^2+\gamma^3)}{16b(b-\gamma)(2b-\gamma)^2} \quad (5)$$

Under price discrimination, total welfare is:

$$W = \frac{b(a_1^2+a_2^2)(3b-2\gamma)}{(b-\gamma)(2b-\gamma)^2} \quad (6)$$

By comparing $\bar{W}$ and W, I get that welfare under *offline* third-degree price discrimination is greater than under *offline* uniform pricing when $\gamma > 2(\sqrt{2}-1)b$, which is the same result of Proposition 1 in GL in the case of *online* third-degree price discrimination and *online* uniform pricing. Therefore, it is immediate to observe that it is not the nature (online or offline) of third-degree price discrimination that generates welfare improvement, but merely the fact that the cross-demand parameter, $\frac{\gamma}{b}$, is large enough.

To understand the irrelevance of online competition for the GL result, one could notice that the demand functions in GL are the same as the traditional Singh and Vives (1984) (SV henceforth) demand system. Consider the following parametrization. First, note that parameter γ in GL corresponds to parameter c in SV demand functions. Then, equation (2) above corresponds to the demand functions in SV (p.547) once I impose $b_1 = b_2 = b$ in SV. Indeed, both the demand functions in GL and the demand functions in SV come from the same utility function of the representative consumer: after renaming parameter γ in SV with φ (to avoid confusion with GL notation), it can be observed that when $a_i = \frac{\alpha_i}{\beta+\varphi}$

and $b = \frac{\beta}{\beta^2 - \varphi^2}$, the utility function in SV (p.547) is the same as equation (1) above. Since the SV model does not consider online competition, it is not surprising that the all the results in GL can be replicated by a model with only offline competition.[2]

3. Conclusion

This note has shown that the very fact that the multimarket firm is *online* or *offline* is not necessary in determining whether third-degree price discrimination across different markets is welfare improving or not. What matters is only the magnitude of the cross-demand parameter.

Therefore, I argue that the policy implications in GL could be expanded by claiming that both *online* and *offline* competition should be encouraged under certain circumstances. This is because, under the same circumstances, *offline* competition would get identical results of *online* competition. In other words, the analysis in GL shows that (online or offline) third-degree price discrimination might be welfare improving when certain conditions, concerning the cross-demand magnitude, are satisfied.

References

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[2] Whether the multimarket firm is online or offline is also irrelevant even if the firms choose quantities rather than prices. In this case, welfare is always greater in the case of discrimination by the multimarket firm across the markets. Details are available.