Do Credit Cards Increase (Effective) Retail Prices?

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Abstract

In the case of Ohio v.s. American Express, the Supreme Court ruled in favor of American Express so that merchants are not allowed to steer consumers from one payment method (a premium credit card) to another (a standard card or cash). This ruling solidifies the presence of premium credit cards that offer better consumer rewards but higher merchant fees. To determine the implications of multiple payment methods that vary in fee structure, we develop a model where a mass of consumers use a variety of payment methods within a market. We find that in most cases, and across market structures, all consumers pay a higher effective price (price including consumer rewards) when premium cards are available. This suggests that allowing merchant steering or preventing "accept all cards" clauses would promote lower prices and restore efficiency in retail markets.

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JEL Classifications: L10, L20, L42

1 Introduction

Over the last decade, merchants and credit card companies have engaged in an ongoing conflict surrounding the so called "anti-steering" clauses that credit card companies require. These clauses prevent merchants from asking or persuading their customers to use certain payment methods. In particular, merchants are motivated to steer their customers away from premium reward credit cards offered by American Express because these premium cards also charge higher merchant fees.

More recently, the narrative of this conflict has been captured by the case of Ohio v.s. American Express, No. 16-1454, which culminated to a Supreme Court ruling in June 2018. In their ruling, the Supreme Court sided with American Express and deemed these anti-steering clauses as acceptable. In particular, the Supreme Court argued that two-sided platforms should face more relaxed anti-trust scrutiny because while these premium cards and anti-steering clauses might harm merchants, the Supreme Court argues that the premium cards have benefited many consumers and expanded credit card usage.

While the justices agreed that both sides of the marker are important, the justices disagreed on whether or not American Express's methods promoted credit card competition. For example, Justice Thomas argued that competition increased by citing expanded consumer credit card acquisition over this time frame; at the same time, Justice Breyer had a different perspective: "If American Express' merchant fees are so high that merchants successfully induce their customers to use other cards, American Express can remedy that problem by lowering those fees or by spending more on cardholder rewards so that cardholders decline such requests. What it may not do is demand contractual protection from price competition."[1]

Since the Supreme Court ruling, the conflict between merchants and credit card companies has continued. Now, however, merchants are claiming that the justices' focused entirely

[1]See "Supreme Court Sides With American Express on Merchant Fees," in the New York Times, June 25, 2018, for details on the Supreme Court ruling.

on the effects to credit card competition and failed to account for the impact that protected premium payment methods will have on the underlying prices in retail markets. More specifically, the merchants argue that with more premium card holders, the higher fees incurred by merchants are passed onto consumers resulting in higher retail prices than would otherwise be the case if steering were allowed or fees were regulated.[2] And with higher prices, sales decrease, a deadweight loss is generated, and consumers are harmed.

One caveat that is missing from the merchants' argument is how the *effective* retail price is impacted by the availability of a premium credit card. By effective price, we simply mean the price that consumers actually pay which depends on the posted retail price and any consumer rewards from the payment method they use. By considering the effective price with respect to the merchants' argument, it is possible that the pass-through from higher merchant fees is less than the improved consumer reward from a premium credit card so that premium users benefit from anti-steering. However, if the merchant fee pass-through is greater than the consumer benefit from a premium reward, then both premium and non-premium users are worse off in the retail market.[3]

To consider how the Supreme Court's ruling of allowing anti-steering clauses impacts effective prices, we depart from the two-sided market approach that considers consumer and merchant credit card acquisition.[4] Instead, we take the saturation of payment methods as given and consider the impact that multiple payment methods have on a retail market. Furthermore, given the imperative connection between market structure and economic pass-through,[5] we consider two market structure extremes, a monopoly and perfect competition, in an attempt to provide a general answer to how premium credit cards impact retail prices.

We find that greater premium card usage generally reduces output which generates a

[2]See ""Are Other People's Credit-Card Rewards Costing You Money? Amazon and other retailers believe so, and they're going to war against high-end cards.," in the New York Magazine, October 16, 2018, for a detailed discussion.

[3]Note, that non-premium users are always worse off because they incur the pass-through from the premium merchant fee but do not earn the premium benefit.

[4]In our discussion, we consider the implications of our model to the acquisition subgame.

[5]See Weyl and Fabinger (2013) for details.

deadweight loss. Furthermore, the effective price that premium users pay is often higher when the premium method is protected. In this case, the merchants' argument is sound: anti-steering raises prices for all consumers (inclusive of rewards) which reduces output and generates an inefficiency within retail markets. In the special case where consumer rewards are close to merchant fees and few premium users exist, the premium users face a lower effective price than if steering was allowed; however, the majority of consumers in this case (the non-premium users) are made worse off. Importantly, all these results are consistent across the two market structures which suggests that our results are likely robust to other competition structures that fall between monopoly and perfect competition.

Much of the literature on credit cards takes a two-sided market approach with the objective of analyzing credit card acquisition, competition, and optimal fee structures. Rochet and Tirole (2002), Rochet and Tirole (2003), Wright (2003), and Wright (2004), pioneered this work by considering the connection between payment cards, card issuers, and merchants and consumers. These papers have been highly influential in terms of how different interchange fees impact credit card acquisition, how we require a no-surcharge rule on merchants to ensure acquisition, and how issuers and credit card companies set optimal fees. However, with a focus on credit card acquisition and interchange fees, these papers take a simplistic approach in how they model the final goods market and so they are unable to inform us on the impact that a variety of payment methods will have on retail prices.

Following these seminal papers, others have considered important features of credit card markets that relate to steering or premium credit cards. Carlton and Winter (2018) highlight how the traditional methods for evaluating vertical most-favored-nation restraints remain effective for evaluating credit card no-surcharge rules (which amount to anti-steering) in two-sided markets. However, they assume that merchants pass through the entire merchant fee onto consumers in order to consider a richer two-sided credit card model. Schwartz and Vincent (2017) consider the impact that asymmetric credit card fees have on credit card competition. They find that pure strategy equilibria in credit card fees cannot exist because

credit cards compete by trying to outdo each other's spread between the merchant fee and consumer reward. Unfortunately, they model the retail market by considering a monopoly merchant and they only consider fixed fees and rewards (opposed to the proportional ones that are observed); these assumptions naturally generate specific results about merchant fee pass-through and so a richer model of retail is required.[6]

One paper that is most similar to ours is Shy and Wang (2011) who consider a model where credit cards are already saturated in the market and consumers purchase some items with cash and other items with a credit card. They focus on the impact of different types of credit card fees: fixed or proportional. However, merchants specialize in either goods purchased by card cards or goods purchased with cash; thus, no goods are purchased with multiple payment methods. This implies that we are unable to determine how multiple payment methods within a particular market impact pricing an efficiency using their model.

2 The Model

It is common for a variety of payment methods to be used to make purchases within a particular market (e.g., cash, debit cards, standard credit cards, and premium credit cards). For simplicity, suppose that there are two payment methods: a premium credit card and a standard payment method which could simply be cash, a debit card, or a standard credit card. In addition, we normalize the standard payment method fees and rewards to zero.

Suppose there exists a unit mass of consumers that each have unit demand for a product. Consumer values, v, are drawn from the distribution $F(\cdot)$, and if all consumers use the standard payment method for a product sold at posted price p, then a standard demand curve follows: $q = 1 - F(p)$. However, with multiple payment methods, consumers pay different effective prices because premium consumers earn rewards. Furthermore, consumer

[6]There has been very little empirical evidence that considers the issue of steering in credit card markets. One paper by Briglevics and Shy (2014) find that the use of surcharge rules that provide discounts to cash and debit payment methods steer consumers towards those methods; however, the cost savings for merchants is small.

rewards are proportional to the posted price so that an item purchased at posted price p generates $f_1 \cdot p$ cash back, where $f_1 > 0$ denotes the reward to consumers. This implies that the effective price paid by a premium consumer is $(1 - f_1)p$ while consumers using the standard method face an effective price of p.

Let $\lambda \in [0, 1]$ denote the consumers that use the premium method so that $(1 - \lambda)$ is the mass of consumers using the standard method. Given the distribution of payment methods, an item sold at posted price p has demands across payment methods given by:

$$q_H = \lambda \cdot [1 - F((1 - f_1)p)], \tag{1}$$

$$q_L = (1 - \lambda) \cdot [1 - F(p)], \tag{2}$$

where subscript H denotes the sales made to premium users and subscript L denotes the sales made to standard users.

Now consider the merchants. On sales made to premium users, merchants only receive $(1-f_2)\cdot p$, where f_2 is the fee taken by the credit card company. We assume that $f_2 > f_1 > 0$ so that profit for credit card companies is non-negative. Depending on the competition structure within the market, the number of merchants will vary. However, the total profit, across all merchants, that is generated from a posted price of p is given by:[7]

$$\Pi = [(1 - f_2)p - c] \cdot q_H + (p - c) \cdot q_L, \tag{3}$$

where c denotes the marginal cost that we assume to be the equal across merchants in the market. Equation (3) highlights how sales made to premium consumers generate less revenue than sales made to standard consumers. Naturally, this distortion will impact equilibrium pricing across different market structures.

[7]At this point, we assume that all merchants accept credit cards (as is the case in most countries). In terms of accepting multiple credit card types, the Supreme Court ruling implies that if a merchant accepts one of a companies credit cards (e.g., a standard credit card), then the merchant must accept all other credit cards offered by that company (e.g., the premium cards).

The timing of the game is as follows. First, premium fees and rewards ($f_2 > f_1 > 0$), the nature of competition between merchants, the distribution of payment methods (λ), and the distribution of consumer values ($F(\cdot)$) are given. Second, merchant competition determines the equilibrium posted price. Finally, consumers make purchases.

3 Equilibrium

Before considering results that are general across market structures, we first consider two extremes: the perfectly competitive market and a monopoly market.

3.1 Perfectly Competitive Merchants

Suppose that there are n merchants in a perfectly competitive (or homogeneous Bertrand) market where total sales are equally split between the n merchants for each payment method. This implies that the equilibrium price, denoted by p^s, is given by setting Equation (3) equal to zero. In this case, we have that $p^s > c$ for all $\lambda > 0$ so that the existence of the premium method generates a deadweight loss.

Proposition 1. *In equilibrium,* $p^s(\lambda) \in \left[c, \frac{c}{1-f_2}\right]$ *with* $p^s(0) = c$, $p^s(1) = \frac{c}{1-f_2}$, *and* $p^s(\lambda) \in \left(c, \frac{c}{1-f_2}\right)$ *for all* $\lambda \in (0,1)$.

This result highlights how efficiency ($p^s = c$) only occurs when no consumer uses the premium method ($\lambda = 0$). With premium users ($\lambda > 0$), the merchants lose money at the efficient price and must charge a markup to generate zero profit. This markup reduces output and generates a deadweight loss. Lastly, if all consumers use the premium method ($\lambda = 1$), then the effective price that all consumers pay is $(1 - f_1) \cdot p^s(1) = \frac{(1-f_1)c}{(1-f_2)} > c = p^s(0)$, and all consumers are worse off than if the premium method were unavailable. In this case the entire merchant fee passes through to consumers whose reward is insufficient to make up for the entire merchant fee resulting in fewer sales and lost surplus.

It is important to note that with both payment methods in use, $\lambda \in (0,1)$, the premium users might be better off. That is, if multiple payment methods are used so that merchants charge a markup, then premium users would benefit when this markup is smaller than the premium reward. Furthermore, such a case is possible when consumer demand is linear:

Proposition 2. *If consumer values are distributed uniformly, $v \sim U(0,1)$, there is a mix of payment methods, $\lambda \in (0,1)$, and $f_i \cdot f_j \approx 0$ for all $i,j = 1,2$,*[8] *then premium consumers pay a higher effective price, $(1-f_1)p^s(\lambda) > p^s(0)$, if and only if $f_2 > \frac{f_1}{\lambda}$.*

The main implication of this result is that if rewards are sufficiently less than merchant fees or the number of premium users is sufficiently large, $f_1 < \lambda \cdot f_2$, then all consumers are worse off with the availability of the premium payment method. Alternatively, if rewards are sufficiently close to merchant fees and the amount of premium users is sufficiently low, then only the standard consumers are worse off with the availability of the premium payment method while the premium consumers are better off.

Fortunately, this result is also easy to test. For example, most merchant fees are around 3% while rewards are typically 1%. In this case, credit card users are better off when at most a third of transactions are made with a credit card, $\lambda < \frac{0.01}{0.03} = \frac{1}{3}$. Unfortunately, data on the percent of credit card transactions is limited; especially at disaggregated levels (like a single market modeled here). However, the Federal Reserve does provide some information on payment method usage. Using survey data, Greene and Stavins (2018) find that 27% of payments are made with credit cards (relative to cash and debit options). At the same time, Greene and Stavins also point out that credit card purchases are more common for more expensive purchases and for purchases made online. These numbers imply that on average, credit card users are better off since $0.27 < 0.33$; at the same time, more expensive products and products that are typically sold online are likely candidates for markets where credit card usage is increasing the effective price for all consumers.

In terms of policy, Propositions 1 and 2 suggest that premium payment methods (and

[8]Typically credit cards have $f_1 = 0.01$ and $f_2 = 0.03$ so that $f_i \cdot f_j \approx 0$ for all $i,j = 1,2$.

credit cards in general) generate an inefficiency. This implies that allowing steering in perfectly competitive markets will likely lower the effective price for all consumers. In this case, steering would generate a Pareto improvement for both merchants and consumers and restore efficiency within the market.

3.2 A Monopoly Merchant

Now consider a market that is supported by a monopoly merchant. To simplify the analysis we consider the case of linear demand. Specifically, suppose that consumer values are distributed uniformly: $v \sim U(0,1)$. In this case, the demand Equations (1) and (2) imply that an item sold at posted price p has demands given by:

$$q_H = \lambda \cdot [1 - F((1-f_1)p)] = \lambda \cdot [1 - (1-f_1)p], \tag{4}$$

$$q_L = (1-\lambda) \cdot [1 - F(p)] = (1-\lambda) \cdot [1-p]. \tag{5}$$

Given demands, the monopoly merchant's profit is given by:

$$\Pi = [(1-f_2)p - c] \cdot \lambda \cdot [1 - (1-f_1)p] + (p-c) \cdot (1-\lambda) \cdot [1-p]. \tag{6}$$

By solving the merchant's problem we have the following result:

Proposition 3. *In equilibrium,*

$$p^*(\lambda) = \frac{\lambda[(1-f_2) + (1-f_1)c] + (1-\lambda)(1+c)}{2[\lambda(1-f_1)(1-f_2) + (1-\lambda)]}, \tag{7}$$

with $p^*(0) = \frac{1+c}{2}$, $p^*(1) = \frac{(1-f_2)+(1-f_1)c}{2(1-f_1)(1-f_2)}$, *and* $\frac{\partial p^*}{\partial \lambda} > 0$ *for all* $\lambda \in [0,1]$.

Like the case of perfectly competitive merchants, the most efficient outcome occurs when no consumer uses the premium method ($\lambda = 0$). With premium users ($\lambda > 0$), some of the merchant fee is passed through to the consumers so that the equilibrium price increases.

This reduces output and generates deadweight loss. In the extreme case where all consumers use the premium method ($\lambda = 1$), the effective price that consumers pay is $(1 - f_1) \cdot p^*(1) = \frac{(1-f_2)+(1-f_1)c}{2(1-f_2)} > \frac{1+c}{2} = p^*(0)$, and all consumers are worse off than if the premium method was unavailable.

With a mix of payment methods, $\lambda \in (0, 1)$, it again is possible for premium users to be better off. As in the case of perfect competition, this requires that λ and f_2 be sufficiently small; otherwise, all consumers are worse off with the existence of the premium method.

Proposition 4. *Premium users pay a higher effective price,* $(1 - f_1)p^*(\lambda) > p^*(0)$*, if and only if* $f_2 > f_1 + \phi(\lambda)$ *where* $\phi(\lambda) \to \infty$ *as* $\lambda \to 0$ *and* $\phi(\lambda) \to 0$ *as* $\lambda \to 1$*.*

As in the case of perfectly competitive merchants, if rewards are sufficiently less than merchant fees or the number of premium users is sufficiently large, then all consumers are worse off with the availability of the premium payment method. Further like the case of perfectly competitive merchants, if the difference between the merchant fee and the consumer reward is sufficiently small and if the number of premium users is sufficiently small, then the premium users pay a lower effective price and are better off.

Comparing Across Market Structures

Comparing our results across the two market structures we see that our findings are largely robust. First, by comparing Propositions 1 and 3 we see that each market structure is most efficient when there are no premium users. These propositions also show that if all consumers are premium users, then the effective price that all consumers pay is higher than the case without the premium method. Combined these findings highlight how premium credit cards generate an inefficiency that is common across market structures. In addition, these findings suggests that effective prices would decrease across all market structures if steering were allowed.

With a mix of payment methods, our results remain robust across market structures. In particular, by comparing Propositions 2 and 4 we see that for a small difference between the

merchant fee and consumer reward and with sufficiently few premium users, the premium users pay a lower effective price and are better off. Thus, policies that either cap the amount of premium credit card acquisitions or that limit the difference between consumer rewards and merchant fees would result in a marketplace where premium users benefit by paying a lower effective price.

Collectively, these results allow us to provide an answer to the question posed by this paper: Does the use of premium credit cards increase the effective price that consumers pay? Across the two market structures, the answer is generally yes, but special cases do exist where premium users might pay a lower effective price relative to the market price where the premium method is unavailable. In light of this result, there are several policies to consider that might alleviate this inefficiency within retail markets.

4 Discussion

In this section we briefly discuss the implications of our findings to the context of existing policy debates. In particular, we apply our results to the ongoing debate of regulating premium credit cards, merchant steering, retailer credit card offerings, and the credit card acquisition game by consumers and merchants.

4.1 Credit Card Acquisition: A Prisoner's Dilemma Game?

Prior to policy considerations, first consider the premium credit card acquisition game by consumers and merchants. By not using the premium payment method, a consumer is losing out on the premium rewards that effectively lower the price that they face. At the same time, a merchant loses sales by not accepting premium credit cards. Thus, both consumers and merchants have an incentive to acquire the premium payment method. However, by all agents acquiring the premium payment method, our results show that all consumers then pay a higher effective price (the price inclusive of the reward). This is obviously inefficient

relative to the outcome where no one uses the premium method. In other words, the credit card acquisition game between consumers and merchants is akin to the classic prisoner's dilemma game where every agent has an incentive to acquire the premium method but all agents would be better off if they collectively avoid the premium option. This suggests that the use of policy or side payments (in the form of steering or surcharges) is necessary to obtain the welfare improving outcome.

4.2 Premium v.s. Standard Credit Cards

In many ways, our results suggest that credit card usage is harmful. However, it is important to note that there are many potential benefits from credit cards that we abstracts from in our model. As a result, one must be very considerate when interpreting our results to certain credit card issues. If we use our model to consider the comparison of cash and standard credit cards, then our results imply that standard credit cards increase the effective prices that consumers pay. But we also know that standard credit cards also provide many benefits to consumers that are not accounted for in our model (e.g., theft protection and easier online shopping). Thus, the benefits from standard credit cards clearly outweigh the inefficiency that they generate in the form of higher effective prices. Instead, if we use our model to consider the comparison between standard and premium credit cards, then our model is no longer abstracting from these benefits since the standard credit cards already provide theft protection and easier online shopping. Hence, in this case where the main benefits of credit cards are already obtained through standard cards, our results suggest that premium credit card usage is largely harmful.

4.3 Steering and "Accept All Cards" Clauses

The majority of credit card companies like Visa, Mastercard, and American Express have an "accept all cards" requirement that forces retailers to accept all of their standard and premium cards. To circumvents the accept all cards requirement, retailers hoped to steer

their consumers by either asking for particular payment methods (cash or standard cards) or by penalizing certain payment methods (premium cards) with a surcharge. If such steering practices are effective, then premium usage will be prevented and efficiency restored.

Unfortunately, the recent Supreme Court ruling sided with the credit card companies and prevents steering. The main consideration throughout this debate was over competition between credit cards. However, such a focus failed to consider the repercussions of premium credit cards on retail prices. Moving forward, one way for merchants to bypass steering is to target these accept all cards requirements. In fact, this is what several major retailers are currently pursing under the argument that such clauses are anticompetitive at the bank level (with respect to interchange fees).[9] While this lawsuit is currently ongoing, a federal court ruling in favor of the retailers would allow retailers to directly steer their consumers by declining premium credit cards while accepting standard ones, and our findings suggest that this would lowering effective prices and improve efficiency within retail markets.

4.4 Retailers Offering Credit Cards

In many ways, our findings resemble the issue of double marginalization in the vertical supply chain. Here, the merchant fee reduces sales and generates an inefficiency in the retail market. This resemblance also provides potential solutions to the credit card double marginalization problem. In particular, merchants can offer their own credit card which is commonly done by major retailers like Macy's, Amazon, and Target. This resolution is akin to the vertical merger solution for the standard problem of double marginalization.

Another potential solution is for merchants to negotiation rates with credit card companies. Following the Supreme Court's ruling on steering, many major retailers began negotiating alternative rates on premium cards.[10] The retailers claim that the intention of these negotiations is to keep retail prices low, and our model suggests that this objective is legit-

[9]See ""Are Other People's Credit-Card Rewards Costing You Money? Amazon and other retailers believe so, and they're going to war against high-end cards.," in the New York Magazine, October 2018, for details.

[10]See ""Are Other People's Credit-Card Rewards Costing You Money? Amazon and other retailers believe so, and they're going to war against high-end cards.," in the New York Magazine, October 2018, for details.

imate and will improve market efficiency if a deal is reached. Thus, policy makers should not necessarily consider such negotiations between retailers and credit card companies as collusive or anticompetitive.

5 Conclusion

In this paper, we aim to determine how the effective prices (prices inclusive of credit card rewards) in retail markets are impacted by the use of multiple payment methods. We find that the pass-through of the premium merchant fee is often greater than the premium reward to consumers so that all consumers, premium and non-premium, pay a higher effective price when premium cards are available in the market. This result holds except for the special case where the difference between the merchant fee and consumer reward is sufficiently small and the number of premium consumers is sufficiently low in which case the premium consumers pay a lower effective price. Both these results are consistent across two market structure extremes, a monopoly and perfect competition, which suggests that they are robust across other forms of competition within a retail market.

Given that premium payment methods generally increase the effective price, policy makers should allow practices that prevent the use of these cards. This suggests that the Supreme Court ruling to prevent steering is harmful to consumers within retail markets. However, our results also suggests that policy makers can rectify this mistake by banning credit card company "accept all cards" clauses. This would better enable merchants to limit premium card purchases without losing sales to standard credit card users.

Appendix of Proofs

Proof of Proposition 1: Setting Equation (3) equal to zero implies that the perfectly competitive equilibrium price is $p^s(0) = c$ and $p^s(1) = \frac{c}{1-f_2}$. Lastly for $\lambda \in (0,1)$, a price $p > \frac{c}{1-f_2}$ implies a merchant earns profit and a price $p < c$ implies a merchant loses money. Thus, $p^s(\lambda) \in \left(c, \frac{c}{1-f_2}\right)$ for $\lambda \in (0,1)$. □

Proof of Proposition 2: With consumer values being distributed uniformly, $v \sim U(0,1)$, we have that Equation (1) implies that $q_H = \lambda[1-(1-f_1)p]$ and Equation (2) implies that $q_L = (1-\lambda)[1-p]$. By substituting these into Equation (3) we have that

$$\Pi = [(1-f_2)p - c] \cdot \lambda[1-(1-f_1)p] + (p-c) \cdot (1-\lambda)[1-p].$$

Note that premium users pay a higher effective price if $(1-f_1)p^s > c$. Thus, if $p = \frac{c}{1-f_1}$, then profit is given by

$$\Pi = \left[\frac{(1-f_2)c}{1-f_1} - c\right] \cdot \lambda[1-c] + \left(\frac{c}{1-f_1} - c\right) \cdot (1-\lambda)\left[1 - \frac{c}{1-f_1}\right],$$

and if $\Pi < 0$, then $p = \frac{c}{1-f_1}$ is less than the equilibrium price p^s so that premium users pay a higher effective price: $(1-f_1)p^s > c$. After some algebra, $\Pi < 0$ if

$$0 > (1-f_1-c)f_1 + \lambda \cdot [(1-c)(-f_2+f_1f_2) + cf_1^2].$$

With $f_i \cdot f_j \approx 0$ for all $i,j = 1,2$, this reduces to $f_2 > \frac{f_1}{\lambda}$ as desired. □

Proof of Proposition 3: Differentiating Equation (6) with respect to p provides the following first-order condition:

$$0 = (1-f_2)\lambda[1-(1-f_1)p] - (1-f_1)\lambda[(1-f_2)p - c] + (1-\lambda)(1-p) - (p-c)(1-\lambda).$$

Solving for price implies that

$$p^*(\lambda) = \frac{\lambda[(1-f_2)+(1-f_1)c]+(1-\lambda)(1+c)}{2[\lambda(1-f_1)(1-f_2)+(1-\lambda)]}.$$

Solving for $p^*(0)$ and $p^*(1)$ results in $p^*(0) = \frac{1+c}{2}$ and $p^*(1) = \frac{(1-f_2)+(1-f_1)c}{2(1-f_1)(1-f_2)}$. Lastly, differentiating Equation (7) with respect to λ gives

$$\frac{\partial p^*}{\partial \lambda} = \frac{f_1(1-f_2)+f_2c(1-f_1)}{4[\lambda(1-f_1)(1-f_2)+(1-\lambda)]^2} > 0$$

□

Proof of Proposition 4: Using Equation (7) we have that $(1-f_1)\cdot p^*(\lambda) > p^*(0)$ occurs when

$$(1-f_1)\frac{\lambda[(1-f_2)+(1-f_1)c]+(1-\lambda)(1+c)}{2[\lambda(1-f_1)(1-f_2)+(1-\lambda)]} > \frac{1+c}{2},$$

which reduces to

$$f_2 > f_1 + \frac{(1-\lambda)\cdot f_1\cdot(1+c)}{\lambda\cdot(1-f_1)\cdot c}.$$

Define $\phi(\lambda) = \frac{(1-\lambda)\cdot f_1\cdot(1+c)}{\lambda\cdot(1-f_1)\cdot c}$ and note that $\phi(\lambda)\to\infty$ as $\lambda\to 0$ and $\phi(\lambda)\to 0$ as $\lambda\to 1$. □

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