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Do No-Surcharge Rules Increase Effective Retail Prices?*

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Abstract

In this paper, we determine how a no-surcharge rule (NSR) impacts effective prices in retail markets (prices that include any consumer payment rewards). This question is fundamentally related to policy, and we provide robust answers by considering how a variety of market structures are impacted by multiple payment methods and different surcharging rules. We find that when a no-surcharge rule is applied, effective prices in a particular market are often higher across all payment methods. In this case, the no-surcharge rule protects a double marginalization effect where the premium payment method inserts an additional margin that harms all consumers and all merchants, and this loss in welfare can be rectified by allowing merchant surcharging across payment methods. Our results are robust across retail market structures, suggesting that NSRs are generally harmful (except for the payment companies).

Keywords: Credit cards, merchant fees, consumer rewards, Ohio v.s. American Express
JEL Classifications: L10, L20, L42

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1 Introduction

Over the last decade, merchants have engaged in an ongoing conflict surrounding the so called "anti-steering" or "no-surcharge rule" (NSR) clauses that various payment method companies require. These clauses prevent merchants from asking or persuading their customers to use certain payment methods and are naturally binding since merchants are motivated to steer their customers away from payment methods that charge higher merchant fees. This debate is especially important for online and digital retailers that are unable to make implicit payment suggests "at the register" and often accept credit cards and online payment methods exclusively. Many of these online retailers, including Amazon, Target, and Home Depot, argue that these premium merchant fees are being passed on to consumers in the form of higher prices.[1]

While this conflict between merchants and payment method companies continues, the recent Supreme Court ruling in June 2018 on the case of Ohio v.s. American Express, No. 16-1454, was a major blow to retailers. In their ruling, the Supreme Court sided with American Express and deemed anti-steering clauses 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 majority of the Supreme Court justices argue that the premium cards have benefited many consumers and expanded credit card usage.[2]

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 on the effects on credit card competition and failed to account for the impact that protected premium payment methods have on the underlying prices in retail markets. More specifi-

[1] 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.

[2] The Supreme Court's ruling has spurred debates on the appropriateness and usefulness of platform economics in antitrust enforcement. Katz (2019) summarizes the important notions that should be carefully treated: including how to define a multi-sided platform in a meaningful way, how to define the "relevant market," and how information on price and output should be used to judge a change in consumer welfare.

cally, 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 surcharging were allowed.[3] And with higher prices, sales decrease, a dead-weight loss is generated, and consumers and merchants are harmed.

One caveat that is missing from the merchants' argument is how the *effective* retail price is impacted by the no-surcharge rule. By effective price, we mean the reward inclusive price that consumers pay. By considering the effective price with respect to the merchants' argument, it is possible that the pass-through from higher merchant fee is less than the consumer reward so that cardholders benefit from the no-surcharge rule. However, if the merchant fee pass-through is greater than the consumer reward, then both credit and cash consumers face higher effective prices and are worse-off.[4]

To understand how the Supreme Court ruling impacts effective prices, we depart from the two-sided market approach of network effects and instead consider how no-surcharge rules impact effective prices and credit card acquisition. Given the imperative connection between market structure and economic pass-through, we implement the conduct parameter approach in which the mode of competition is taken as an exogenous parameter in the retail market.[5] Another important departure that we make from the literature is that we model the merchant fee and consumer reward as ad valorem (instead of fixed). These fees apply to every transaction across all consumer purchases; in addition, many credit cards have an annual fee attached to their membership and so we also include a one-time membership fee to consumers. This structure is meant to provide a model that coincides with the actual payment industry.

[3] 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.

[4] Note, that cash users are always worse off because they incur the pass-through from the merchant fee but do not earn rewards.

[5] This approach dates back to Bowley (1924), and it has recently attracted a renewed interest by, e.g., d'Aspremont and Ferreira (2009) and Weyl and Fabinger (2013). The conduct parameter approach is often used in applied settings such as insurance markets (Agarwal et al. 2014 and Mahoney and Weyl 2017) and vertical relationships (Gaudin 2018 and Adachi 2020).

We find that when merchants can surcharge, credit card usage only occurs when the consumer reward is greater than the merchant fee. That is, no usage occurs when a credit card company extracts rent from each transaction so that double marginalization is prevented under surcharging. In this case, the only potential option for the credit card company is to subsidize transactions while extracting membership fees. We show that such a strategy is not profitable under any set of market structures (even if credit card marginal costs are zero), so that cash is utilized in equilibrium (a result that is common in the literature).

In contrast, when the no-surcharge rule is implemented, the total amount of merchant fees across all cardholders is passed on to *all* consumers which increases the posted price relative to the surcharge case. This implies that the price increase is small (large) when a few (many) cardholders exist. Thus, cardholders can only earn rewards that outweigh the merchant fee pass-through when credit card membership is sufficiently small, and, when membership is large, the merchant fee pass-through outweighs credit card rewards so that all consumers (credit and cash) pay a higher effective retail price in all markets (relative to the case of surcharging). This highlights how a credit card that is protected by a no-surcharge rule is able to position itself into the supply chain, downstream of retail, as the last chain that links retail to consumers.

Much of the literature on payment methods takes a two-sided market approach to analyze 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 a no-surcharge rule is required to ensure acquisition, and how issuers and credit card companies set optimal fees.[6] These papers, and the literature that follows, typically take a simplistic approach in how the final goods market is modeled and

[6]There has been very little empirical evidence that considers the issue of surcharging 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.

instead focus on optimal acquisition and interchange fees. This implies that these models are unable to determine the impact that different market structures have on consumers and merchants when multiple payment methods are present.

Following these seminal papers, others have considered important features of credit card markets that relate to no-surcharge rules. In a similar effort to explain the Supreme Court's ruling, Carlton and Winter (2018) compliment our work by focusing on the impact of the no-surcharge rule on the two-sided credit card market (instead of investigating the impact of these rules on the underlying retail markets). They highlight how the methods for evaluating vertical most-favored-nation (vMFN) clauses in traditional markets remain effective for evaluating the credit card no-surcharge rules in two-sided markets. By taking different approaches to consider a similar problem, our results collectively suggest that the Supreme Court's ruling was misguided for two reasons: (i) Carlton and Winter (2018) show that the no-surcharge rule ensures credit card fees that are higher than the monopoly credit card company case and (ii) we show that the no-surcharge rule can result in higher effective prices for all consumers across all retail markets.[7]

One paper that is 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 credit cards or goods purchased with cash; thus, no goods are purchased with multiple payment methods in their model. This implies that one is unable to determine how multiple payment methods within a particular market impact pricing and efficiency.[8]

[7]Schwartz and Vincent (2020) 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, Schwartz and Vincent (2020) model the retail market by considering a monopoly merchant and they only consider fixed fees and rewards (opposed to the proportional ones observed and modeled in this paper); these assumptions naturally generate specific results about merchant fee pass-through and so a richer model of retail is required. Similarly, Schwartz and Vincent (2006) also consider the no-surcharge rule but model merchants as monopolists and largely focus on optimal fee structures.

[8]Bourguignon et al. (2019) also provide a rich set of predictions for merchant payment policy as well as the fee structure designed by assuming that card acceptance and surcharging are "shrouded" for consumers.

Two other papers that relate to ours are Edelman and Wright (2015) and Liu et al. (2021). Edelman and Wright (2015) present a general framework for intermediaries using no-surcharge rules and they find that consumer surplus is harmed by no-surcharging but the effect on welfare is ambiguous. In their setting, the retail sector is modeled as an oligopoly market where the entire consumer demand is satisfied (implying no extensive margin). This is a crucial assumption since the extensive margin is key to determining dead-weight loss and any double marginalization effect that may arise from merchant fees. Instead, Liu et al. (2021) include an extensive margin on demand by considering a market with log-concave demand that is served by a monopoly merchant. They find that the no-surcharge rule can increase consumer surplus much like third-degree price discrimination can improve consumer surplus under the right demand specifications.

There are a few notable differences that drive the differences in results between these two papers and our own. First and foremost, both Edelman and Wright (2015) and Liu et al. (2021) use fixed, not ad valorem, consumer rewards and merchant fees which naturally have pass-through rules that differ from the ad valorem structure used in our model and observed in the payment industry. Second, like Liu et al. (2021), we include an extensive margin on demand; however, we also consider retail across market structures. As a result, we show that a no-surcharge rule will generally result in higher effective prices, harming all merchants and at least the cash consumers, so that all agents can be made worse off than in the case of surcharging.

2 The Model

Consumers make purchases across a plethora of markets while using a variety of payment methods (e.g., cash, debit cards, standard credit cards, premium credit cards, cryptocurrencies, etc.). Suppose that two payment methods are available to consumers: a premium payment method (a credit card) and a regular payment method (cash). We normalize the regular payment method fees and rewards to zero, but we assume that the credit card includes a cash-back reward (r), a merchant fee (f), and a consumer sign-up fee (F).[9]

2.1 Consumers

To model extensive consumer shopping, suppose there exists a unit mass of markets and let an individual market be denoted by $m \in [0, 1]$. Similarly, there is a unit mass of consumers that have unit demands for each product. A consumer's value in market m is drawn from the distribution $G_m(v)$ which are independent across $m \in [0, 1]$. A consumer's value in market m is drawn from the distribution $G_m(v)$, which are independent across $m \in [0, 1]$. In terms of total purchases, this implies that consumers are homogeneous in expectation, but heterogeneous in practice since some consumers will obtain more draws above the equilibrium prices than others.

To understand how the no-surcharge rule impacts pricing and welfare, we consider both surcharging and no-surcharging cases. Let p^c_m (resp. p^{cc}_m) denote the posted price to cash (resp. credit card) consumers in market m. If merchants are allowed to surcharge, then p^{cc}_m need not equal p^c_m. In this case, a consumer who signs up for a credit card pays the initial fee F and then receives rewards that are proportional to the credit card posted price. That is, item m purchased at p^{cc}_m generates $r \cdot p^{cc}_m$ cash back. This implies that the effective price paid by a credit card consumer is $(1 - r)p^{cc}_m$, while consumers using cash pay an effective price of p^c_m. Instead, if the no-surcharge rule is in place, then $p_m = p^{cc}_m = p^c_m$ and credit card consumers pay an effective price of $(1 - r)p_m$, while cash consumers pay an effective price of p_m.

Altogether this implies that, given r, F, p^c_m, and p^{cc}_m, a consumer purchases a credit card if

$$F \leq \int_0^1 \mathbb{1}\{v_m - (1 - r)p^{cc}_m \geq 0\} \cdot [p^c_m - (1 - r)p^{cc}_m]dm, \tag{1}$$

[9]Premium credit cards that offer better rewards often include an annual fee to consumers. In our static setting, we model this with the sign-up fee.

where $\mathbb{1}\{v_m - (1-r)p_m^{cc} \geq 0\}$ captures whether or not the consumer purchases product m and $[p_m^c - (1-r)p_m^{cc}]$ captures the savings that the consumer enjoys from using the credit card in market m instead of cash.[10]

2.2 Merchants

On the merchant side, a sale made to a credit card (cash) consumer generates $(1-f) \cdot p_m^{cc}$ (p_m^c) in revenue. To understand how credit cards with the no-surcharge rule impact market outcomes, we must develop a model that allows for a variation in market structure. If the no-surcharge rule impacts monopolies differently than oligopolies, then it is difficult to make policy recommendations that broadly apply to every market. Thus, we implement the conduct parameter approach, as considered by d'Aspremont and Ferreira (2009) and Weyl and Fabinger (2013), to comprehensively investigate the impact that surcharge rules have on effective prices across market conduct.

Let the conduct parameter, $\theta_m \in [0,1]$ in market m, capture the intensity of competition between symmetric merchants where greater θ_m corresponds to less competition. At the extremes, $\theta_m \to 0$ captures competition approaching perfect and $\theta_m \to 1$ corresponds to competition approaching the case of a monopoly merchant. For Cournot competition with n_m symmetric merchants in market m, conduct is given by $\theta_m = \frac{1}{n_m}$. In this way, we are able to capture the degree of competition in a continuous manner with a single parameter without specifying the specific type of competition.

Depending on the nature of competition within a market, the number of merchants may vary. However, the total profit across all merchants in market m is given by:[11]

$$\pi_m(p_m^{cc}, p_m^c) = [(1-f)p_m^{cc} - c_m]Q_m^{cc} + (p_m^c - c_m)Q_m^c,$$

[10] Note that we do not consider cards with market specific rewards. While these cards do exist in practice (e.g., some cards offer better rewards for gasoline or restaurants), we leave such an extension for future research.

[11] We assume that all merchants accept the two payment methods (as is the case in most markets where merchants accept cash, debt, and credit).

where $c_m \geq 0$ denotes a merchant's marginal cost, Q_m^{cc} denotes credit card demand, and Q_m^c denotes cash demand for market m.[12]

2.3 The Credit Card Industry

For simplicity, we assume that the credit card is provided by a single company and we discuss credit card competition in an extension. The credit card company's profit is given by:

$$\Pi = \left[\int_0^1 (f - r - t) p_m^{cc} \cdot Q_m^{cc} dm \right] + \lambda \cdot F,$$

where $t \geq 0$ is the transaction level marginal cost associated with a purchase (e.g., the expected cost of a charge being fraudulent) and $\lambda \in [0, 1]$ denotes the mass of consumers that acquire the credit card.

2.4 The Timing

The timing of the game is as follows. First, all agents observe the nature of competition in each market (θ_m for all $m \in [0, 1]$) and consumers observe their values for each market, v_m. Next, the credit card company (or a regulator) chooses whether or not to enforce the no-surcharge rule (NSR) and then sets fees and rewards (r, f, F). Consumers observe the regime and fees and then choose whether or not to sign up for the credit card. Finally, the equilibrium market prices are determined based on credit card fees and the number of cardholders.

[12] For simplicity, we assume equal marginal costs across merchants.

2.5 Market Conduct in the Retail Subgame

Before solving the game, we first discuss how multiple payment methods impact our conduct parameter approach. Given the distribution of payment methods demands are given by:

$$Q_m^{cc} = \lambda \cdot [1 - G_m((1-r)p_m^{cc})],$$

$$Q_m^{c} = (1-\lambda) \cdot [1 - G_m(p_m^{c})].$$

To illustrate the conduct parameter approach in our setting, first consider the simple case with only a single payment method: cash. In this case, the industry profit for market m is given by $\pi_m = (p_m - c_m) \cdot Q_m$ so that the monopoly first-order condition is given by $Q_m + \frac{dQ_m}{dp_m} \cdot (p_m - c_m) = 0$. Applying the conduct parameter approach implies that the traditional market equilibrium satisfies:[13]

$$\frac{p_m - c_m}{p_m} \cdot |\epsilon_m| = \theta_m,$$

where $\epsilon_m = -\frac{p_m}{Q_m}\frac{dQ_m}{dp_m}$ is the price elasticity of demand in market m.

Extending this approach to multiple payment methods, first consider the surcharge regime where p_m^{cc} need not equal p_m^{c}. In this case, the industry profit for market m is given by $\pi_m = [(1-f)p_m^{cc} - c_m]Q_m^{cc} + (p_m^{c} - c_m)Q_m^{c}$ so that merchant profits are independent across payment methods. The monopoly first-order condition with respect to p_m^{cc} is given by $(1-f)Q_m^{cc} + \frac{dQ_m^{cc}}{dp_m^{cc}} \cdot [(1-f)p_m^{cc} - c_m] = 0$ and the first-order condition with respect to p_m^{c} implies that $Q_m^{c} + \frac{dQ_m^{c}}{dp_m^{c}} \cdot (p_m^{c} - c_m^{c}) = 0$. Applying the conduct parameter approach implies that the surcharging subgame equilibrium satisfies:

$$\theta_m \cdot (1-f) \cdot Q_m^{cc} = -\frac{\partial Q_m^{cc}}{\partial p_m^{cc}} \cdot [(1-f)p_m^{cc} - c_m], \tag{2}$$

[13] Note that this condition is identical to the first-order condition for the Cournot model with n symmetric firms and $\theta = \frac{1}{n}$.

$$\theta_m \cdot Q_m^c = -\frac{\partial Q_m^c}{\partial p_m^c} \cdot (p_m^c - c_m). \tag{3}$$

For the no-surcharge rule case, $p_m^{cc} = p_m^c = p_m$ implies that the industry profit for market m is given by $\pi_m = [(1-f)p_m - c_m]Q_m^{cc} + (p_m - c_m)Q_m^c$ so that the monopoly first-order condition with respect to p_m is given by $[(1-f)Q_m^{cc} + Q_m^c] + \frac{dQ_m^{cc}}{dp_m} \cdot [(1-f)p_m^{cc} - c_m] + \frac{dQ_m^c}{dp_m} \cdot (p_m^c - c_m^c) = 0$. Applying the conduct parameter approach implies that the no-surcharge subgame equilibrium satisfies:

$$\theta_m \cdot [(1-f)Q_m^{cc} + Q_m^c] = -\frac{\partial Q_m^{cc}}{\partial p} \cdot [(1-f)p_m - c_m] - \frac{\partial Q_m^c}{\partial p_m} \cdot (p_m - c_m). \tag{4}$$

3 Equilibrium Analysis

We solve for the Subgame Perfect Nash Equilibrium (SPNE) using backward induction considering each of the regime in turn. To determine the SPNE, we first derive the equilibrium retail prices for each regime, given the credit card fees and the number of card holding consumers. Second, we determine the number of consumers that become cardholders based on credit card fees and expected retail prices. Finally, the credit card company's optimal fees are derived in light of the continuation subgames. To simplify our analysis, suppose that consumer values are distributed uniformly so that $v_m \sim U(0,1)$ and let $c_m \in [0,1)$.

3.1 The Case of Surcharging

To determine retail pricing for the case of surcharging, note that cardholders are enticed to use cash whenever the effective credit card price is greater than the effective cash price. That is, no credit card usage occurs when $(1-r)p_m^{cc} > p_m^c$. Solving for retail prices, given premium fees (r and f) and cardholdership (λ), we have the following result:

Lemma 1. *If merchants can surcharge, then cash and credit card prices are given by*

$$p_m^{cc} = \frac{c_m}{(1+\theta_m)(1-f)} + \frac{\theta_m}{(1+\theta_m)(1-r)}, \tag{5}$$

$$p_m^c = \frac{c_m + \theta_m}{1+\theta_m}, \tag{6}$$

and cardholders use their credit card in every market (for all θ_m) if $f \leq r$; otherwise, if $f > r$, then cardholders and cash consumers use cash in every market (for all θ_m).

Note that merchants prefer the credit card over cash when $(1-f)p_m^{cc} > p_m^c$ and cardholding consumers prefer the credit card over cash when $(1-r)p_m^{cc} < p_m^c$. Equations (6) and (5) imply that each condition holds if and only if $r \geq f$ so that consumers and merchants payment preferences are perfectly aligned with surcharging. In addition, the condition for credit card existence, $r \geq f$, highlights how the credit card company must inject surplus into the market in order to survive in the surcharging regime. We will show in the next subsection that such a requirement is not necessary in the no-surcharge regime.

To determine credit card acquisition with surcharging, note that if $r < f$, then no consumer purchases the credit card since the card will never be used (by Lemma 1). However, if $r \geq f$ and a consumer expects prices p_m^c and $p_m^{cc}(r, f)$ in market m, then consumer i will expect to make purchases from $M_i^S \subset [0, 1]$ markets. This implies that Equation (1) reduces to $F \leq \int_{M_i^S} [p_m^c - (1-r)p_m^{cc}(r, f)] \, dm := R^S(i)$.[14] For the surcharging subgame, we order the unit mass of consumers from highest to lowest by expected total rewards so that $R^S(i)$ is decreasing in i. To ease exposition, we focus on distributions of (θ_m, c_m) so that $R^S(i)$ is continuous in i. This implies that there exists a $\lambda^S(r, f, F) \in [0, 1]$ that is implicitly defined by $R(\lambda^S(r, f, F)) = F$ so that a consumer $i \in \left[0, \lambda^S(r, f, F)\right]$ purchases the credit card and a consumer $i \in \left(\lambda^S(r, f, F), 1\right]$ does not purchase the credit card. This formulation implies that cardholdership $(\lambda^S(r, f, F))$ is decreasing in the membership fee (F) since $R^S(i)$ is a

[14]If our model is simplified to only a single market, instead of the mass of markets, then the total credit card savings $(R^S(i))$ is the same across all consumers so that all consumers that purchase the product either buy the credit card or none of them do. In this case, λ^S is either zero or one.

decreasing function.[15]

Given the credit card acquisition subgame, the credit card company solves the following:

$$\max_{r,f,F} \left[\int_0^1 (f - r - t) p_m^{cc} \cdot Q_m^{cc}(\lambda^S(r, f, F))\, dm \right] + \lambda^S(r, f, F) \cdot F.$$

We see that the credit card company is sustainable with surcharging when $t \leq 0$ (recall that t is the marginal cost of the transaction for the credit card company):

Lemma 2 (The Surcharge Equilibrium)**.** *(i) If merchants can surcharge and $t > 0$, then no consumer becomes a cardholder in equilibrium ($\lambda^S = 0$), and the equilibrium price that every consumer pays in market m is given by:*

$$p_m^S = p_m^c = \frac{c_m + \theta_m}{1 + \theta_m}.$$

The surcharge equilibrium credit card fees are not unique in this case, but $r^S = f^S - t = F^S = 0$ ensure that no agent deviates from this equilibrium. (ii) If $t \leq 0$, then $r^S = f^S$, $F^S = 0$, and $\lambda^S = 1$ so that all consumers use the credit card and equilibrium prices in market m are given by

$$p_m^S = p_m^c = (1 - r^S) p_m^{cc} = \frac{c_m + \theta_m}{1 + \theta_m}. \tag{7}$$

The key takeaway is that credit card usage is always efficient with surcharging. That is, credit card usage occurs exactly when the credit card adds surplus to the market (when $t \leq 0$). However, if the credit card is detrimental to surplus (when $t > 0$), then surcharging prevents credit card usage. This result highlights how the surcharge regime only enables efficient credit cards to gain usage, a result that is robust across all market structures.

[15] Our approach to determining cardholdership utilizes how the mass of markets impacts a consumer's total reward across the plethora of products consumed. Ultimately, we need cardholdership to decrease in F, and others have proposed alternative frameworks that also produce such a result. For example, some take a single market approach with consumers that are heterogeneous with respect to a convenience membership benefit; however, such an approach does not generalize to the AmEx case where standard and premium credit cards differ in royalties and fees. Instead, our approach allows for such a comparison by considering the case where payment methods differ in fees and rewards captured by r, f, and F.

We also see from Lemma 2 that equilibrium effective prices are neutral across payment methods. Another finding that is robust across market structures. This neutrality result coincides with much of the previous literature on payment methods (including Gans and King (2003), Edelman and Wright (2015) and Liu et al. (2021)). Thus, we match with the literature in this respect, and this consistency is not surprising as effective price neutrality with surcharging is a result that should hold across model specifications (as shown in Gans and King (2003)).

3.2 The No-Surcharge Rule (NSR)

We now turn to the no-surcharge rule regime. Solving backwards, we first determine retail pricing for arbitrary fees (r and f) and an arbitrary number of credit card holders (λ):

Lemma 3. *If merchants cannot surcharge across payment types, then the subgame equilibrium retail price is*

$$p_m = \frac{(1-\lambda r)c_m + (1-\lambda f)\theta_m}{(1+\theta_m)[1-\lambda(r+f-rf)]}. \tag{8}$$

Cardholdership with a no-surcharge rule is determined in light of the subgame equilibrium retail prices. Note that if a consumer expects price $p_m(r, f)$ in market m, then consumer i will expect to make purchases from $M_i^{NSR} \subset [0, 1]$ markets. This implies that Equation (1) reduces to $F \leq \int_{M_i^{NSR}} (r + b) \cdot p_m(r, f)\ dm := R^{NSR}(i)$. For the no-surcharge rule subgame, we order the unit mass of consumers from highest to lowest by expected total rewards so that $R^{NSR}(i)$ is a decreasing function. We focus on distributions of (θ_m, c_m) so that $R^{NSR}(i)$ is continuous in i which implies that there exists a $\lambda^{NSR}(r, f, F) \in [0, 1]$ that is implicitly defined by $R(\lambda^{NSR}(r, f, F)) = F$. Thus, a consumer $i \in [0, \lambda^*(r, f, F)]$ purchases the credit card and a consumer $i \in (\lambda^*(r, f, F), 1]$ does not purchase the credit card. This formulation implies that cardholdership ($\lambda^{NSR}(r, f, F)$) is decreasing in the membership fee (F) since $R^{NSR}(i)$ is a decreasing function.

Given the credit card acquisition subgame, the credit card company maximizes the following:

$$\max_{r,f,F} \left[\int_0^1 (f - r - t) p_m(\lambda^{NSR}(f, r, F)) \cdot Q_m^{cc}(\lambda^{NSR}(r, f, F)) \; dm \right] + \lambda^{NSR}(r, f, F) \cdot F.$$

We see that the credit card company is always sustainable with the no-surcharge rule:

Lemma 4 (The NSR Equilibrium). *With a no-surcharge rule, equilibrium credit card fees must be such that either $F^{NSR} > 0$ or $f^{NSR} > r^{NSR} + t$; $\lambda^{NSR} \in (0, 1]$;*[16] *and the equilibrium retail price in market m is given by:*

$$p_m^{NSR} = \frac{(1 - \lambda^{NSR} r^{NSR}) c_m + (1 - \lambda^{NSR} f^{NSR}) \theta_m}{(1 + \theta_m)[1 - \lambda^{NSR}(r^{NSR} + f^{NSR} - r^{NSR} f^{NSR})]}. \tag{9}$$

4 The Price Comparison and Welfare

While our general characterization of shopping across markets prevents a closed form solution of credit card fees and card holder participation in the no-surcharge regime, our approach still allows for a rich comparison between the two regimes since we observe the no-surcharge equilibrium in the credit card industry. Thus, we focus on the equilibrium price comparison across regimes when the no-surcharge fees satisfy constraints observed in the payment industry: $1 > f^{NSR} > r^{NSR} \geq 0$ and $F^{NSR} \geq 0$. Thus, any results derived from such a comparison must be valid for any parameter specification that produces a no-surcharge rule equilibrium that coincides with the credit card industry.

4.1 The Price Comparison

By comparing equilibrium surcharge and no-surcharge prices directly, we see that credit card usage always harms cash consumers:

[16] We have that $\lambda^{NSR} > 0$ so long as costs (t) are sufficiently low.

Proposition 1. *If* $0 < f^{NSR} < 1$ *and* $r^{NSR} < 1$, *then retail prices under NSR are higher than that under surcharging:* $p_m^{NSR} > p_m^S$ *for all* θ_m *and* c_m.

With the no-surcharge rule, credit card fees are passed onto consumers in the form of higher retail prices so that every consumer bears some burden of the credit card merchant fee (f), even those consumers that do not use the credit card. This holds across every level of market conduct so that we can safely argue that cash consumers are always worse-off when credit cards are protected by the no-surcharge rule.

To determine the effect on cardholders, we must consider the effective prices that cardholders pay under the no-surcharge rule: $(1 - r^{NSR})p_m^{NSR}$ versus p_m^S. If the consumer reward outweighs the merchant fee pass-through, then cardholders might benefit from the a credit card that is protected by a no-surcharge rule. More specifically, the following proposition shows that the effective price for cardholders under NSR is lower than the price they pay under surcharging if and only if the number of cardholders is sufficiently low:

Proposition 2. *If* $1 > f^{NSR} > r^{NSR} > 0$, *then there exists a* $\overline{\lambda}(\theta_m) \in (0, 1)$ *such that* $(1 - r^{NSR})p_m^{NSR} < p_m^S$ *if and only if* $\lambda^{NSR} < \overline{\lambda}(\theta_m)$. *Furthermore,* $\frac{\partial \overline{\lambda}}{\partial \theta_m} > 0$.

The results from Proposition 2 highlight the merchant fee pass-through story. With the no-surcharge rule, the total amount of merchant fees across cardholders is passed on to *all* consumers which increases the posted price relative to the surcharge case. This implies that the price increase is small when only a few cardholders exist (when λ^{NSR} is low). However, greater cardholdership (high λ^{NSR}) results in a larger amount of merchant fees which amounts to a larger price increase. Thus, if cardholdership is sufficiently small ($\lambda^{NSR} < \overline{\lambda}$), then the cardholders earn a reward that covers the higher price: $(1 - r)p_m^{NSR} < p_m^S$. Instead, if cardholdership is sufficiently large ($\lambda^{NSR} > \overline{\lambda}$), then the increase in price outweighs the consumer reward and all consumers (cash and card) prefer surcharging: $(1 - r)p_m^{NSR} > p_m^S$.

Using the conduct parameter approach, Weyl and Fabinger (2013) show that a more competitive market has greater pass-through than a less competitive market. We find that a more competitive market (reducing θ_m) requires a lower level of cardholdership to ensure that cardholders are better off $\left(\text{given by } \frac{\partial \overline{\lambda}}{\partial \theta_m} > 0\right)$. This directly fits the Weyl and Fabinger pass-through argument: reducing θ_m results in greater pass-through of merchant fees so that cardholders require fewer cardholders to remain better off.

Combined, Propositions 1 and 2 imply that all consumers pay a higher effective price in every market m where $\lambda^{NSR} > \overline{\lambda}(\theta_m)$. This highlights how a credit card that is protected by a no-surcharge rule is able to position itself into the supply chain, downstream of retail, as the last chain that links retail to consumers. And, the market power that is present within this additional chain generates a double marginalization effect that is otherwise mitigated by surcharging.

4.2 Welfare

While the previous subsection highlights how merchant fee pass-through impacts the effective price comparison between the two regimes, it is important to consider the full picture of welfare. To do so, we continue to focus on the case where market primitives produce a no-surcharge rule equilibrium that coincides with the credit card industry: $1 > f^{NSR} > r^{NSR} \geq 0$ and $F^{NSR} \geq 0$. In this case, Proposition 1 implies that all cash consumers are worse-off with the no-surcharge rule.

Turning to cardholder welfare, we see that the credit card membership fee often varies across credit cards in practice. While some credit cards offer initial membership rewards that might suggest an $F^{NSR} < 0$, these cards often require annual fees after the first year (e.g., airline credit cards that give a free flight upon sign-up but have annual fees). We amount these examples to the case where $F^{NSR} > 0$ in our model. However, there do exist credit card programs that require zero annual/sign-up fees and still provide cash back rewards to consumers.[17] This implies that we should consider the case where $F^{NSR} = 0$ in our model.

[17]For example, Discover offers an entire line of credit cards with consumer rewards and no annual fees; several of them do not have sign-up fees as well.

Proposition 3. *If $F^{NSR} = 0$ and $1 > f^{NSR} > r^{NSR} > 0$, then every consumer purchases the credit card and is worse-off under the NSR than under surcharging: $\lambda^{NSR} = 1$ and $(1 - r^{NSR})p_m^{NSR} > p_m^S$ for all $\theta_m \in [0, 1]$ and $c_m \in [0, 1)$.*

This result provides direct evidence of the double marginalization that stems from the no-surcharge rule. In this case, a credit card company that is protected by the no-surcharge rule and offers consumers a free credit card with cash back will acquire every consumer as a cardholder, but the equilibrium effective price will always be greater than the equilibrium price with surcharging. This outcome is effectively generated by a prisoner's dilemma game where consumers have an individual incentive to acquire the credit card, but all consumers are better off if no consumer acquires the credit card (the surcharge equilibrium).[18]

Many credit cards impose positive annual fees on their consumers so that $F^{NSR} > 0$, $1 > f^{NSR} > r^{NSR} > 0$, and $\lambda^{NSR} < 1$. In this case, Proposition 2 implies that a necessary condition (not a sufficient condition) for *some* cardholders to benefit from the no-surcharge rule is that $\lambda^{NSR} < \overline{\lambda}(\theta_m)$ for all m. Note that not all cardholders will be better off when $\lambda^{NSR} < \overline{\lambda}(\theta_m)$ for all m since $F^{NSR} > 0$ (even though they face lower effective prices across all markets). To see this explicitly, consider the marginal consumer that becomes a cardholder. For this consumer, Equation (1) with $F > 0$ holds with equality so that the consumer is indifferent between using cash and using the credit card in the no-surcharge equilibrium. This implies that the welfare comparison for the marginal consumer is captured by comparing the no-surcharge rule *cash* price to the price with surcharging. By Proposition 1, this marginal consumer is always worse-off from the no-surcharge.

A similar argument holds for other consumers close to the margin of becoming a no-surcharge cardholder: they only purchase a few products so that the cash back from those purchases just covers the credit card membership fee. Nevertheless, the savings from the

[18] Proposition 3 also suggests that credit cards are detrimental to all consumers. However, it is important to note that we do not include any convenience utility from using a card instead of carrying cash. While this convenience utility is obviously important for consumers that use a non-premium credit card instead of cash, many premium credit card offerings are poaching consumers away from non-premium credit cards. In this case, the convenience utility is no longer relevant and our welfare results are accurate. We discuss the issue of premium verses standard credit cards in the context of our model in the next section.

no-surcharge credit card (relative to the surcharge price) do not outweigh the positive membership fee that must be spent to obtain these savings; as a result, the marginal cardholders would prefer the surcharge regime. More formally we have the following:

Proposition 4. *If $F^{NSR} > 0$, $1 > f^{NSR} > r^{NSR} > 0$, and $\lambda^{NSR} < \overline{\lambda}(\theta_m)$ for all $m \in [0, 1]$, then there exists an $\epsilon > 0$ so that every cardholder i with $i \in (\lambda^{NSR} - \epsilon, \lambda^{NSR})$ is worse off from the no-surcharge rule and every cardholder i is better off with $i \in [0, \lambda^{NSR} - \epsilon)$.*

This result highlights how even in the extreme setting where the no-surcharge rule is at its best, some cardholders are still worse off with the no-surcharge rule.

5 Discussion and Extensions

In this section, we briefly discuss the implications of our findings to the context of existing policy debates. In particular, we offer implications for premium v.s. standard credit cards, merchant steering and "accept all cards" clauses, and retailer credit card offerings, followed by comments on optimal card fees and competition between credit cards.

5.1 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 abstract 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 between cash and standard credit cards, then our results imply that standard credit cards increase the effective prices that consumers pay. However, we also know that standard credit cards 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.

Applying a convenience benefit to our model to more accurately portray the comparison between cash and standard credit cards would amount including either a membership benefit B or a transaction benefit b that directly impacts the effective price from using a credit card (in addition to r). In this case, it is possible for the credit card company to earn profit with cardholdership under the surcharge regime. Thus, our model suggests that standard credit card usage will persist and be welfare enhancing if surcharging is allowed.

Instead, if we use our model to consider the comparison between standard and premium credit cards, then our model is no longer abstracting from convenience benefits since the standard credit cards already provide theft protection and easier online shopping. In this case, where the main benefits from credit cards are already obtained through standard cards, our results suggest that premium credit cards that are protected by the no-surcharge rule are largely harmful to consumers and merchants.

5.2 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 circumvent this accept-all-cards requirement, retailers hoped to steer their consumers either by asking for particular payment methods (cash or standard cards) or by penalizing certain payment methods (premium cards) with a surcharge. 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 effective 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). 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 we find that such a policy could lower effective prices for all consumers and improve efficiency within retail markets.

5.3 Retailers Offering Credit Cards

In several ways, our findings resemble the issue of double marginalization in a vertical supply chain. Naturally, the vertical integration solution to double marginalization might apply to the vertical relationship between payment and retail. In particular, merchants can vertically integrate by offering their own credit card. This is common for major retailers like Macy's, Amazon, and Target. Another potential solution is for merchants to negotiate rates with credit card companies as a kind of vertical integration. Following the Supreme Court's ruling on surcharging, many major retailers began negotiating alternative rates on premium cards.[19] The retailers claim that the intention of these negotiations is to keep retail prices low, and our model suggests that this objective is legitimate and will improve market efficiency. Thus, policymakers should not necessarily consider such negotiations between retailers and credit card companies as collusive or anti-competitive.

5.4 Optimal Fees

We do not explicitly solve for the optimal fees set by the credit card company. Instead, we take the approach of showing that our main results hold for any set of primitives that produce the credit card fee structures that are actually observed in the industry. Others have explicitly solved for these fees (e.g., Edelman and Wright (2015) and Liu et al. (2021)). However, they consider stylized settings where payment method fees are optimized over a single market that is facilitated by a monopoly merchant. In reality, optimal fees are optimized over the aggregation of credit card profits across all markets that naturally vary in demand and market structure (as we consider in our model). One paper that takes such

[19]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.

a holistic approach is Bedre-Defolie and Calvano (2013). They consider payment card fees using a two-sided approach (with a mass of consumers and merchants); however, they impose perfectly elastic demand with monopoly merchants across all product markets.

5.5 Competition Among Credit Cards

Throughout our analysis we assume that the market for credit cards is fulfilled by a monopolist. This restriction may not be important as all our main results follow for any credit card competition structure that produces $f^{NSR} > r^{NSR} \geq 0$ and $F^{NSR} \geq 0$, since the surcharging results are effectively independent of credit card competition. This implies that if the transaction marginal cost is greater than zero ($t > 0$), then most of our results hold even when the credit card market is perfectly competitive ($f^{NSR} > r^{NSR} + t > 0$ and $F^{NSR} = 0$).[20]

6 Concluding Remarks

In this paper, we aim to determine how effective prices, defined as prices inclusive of any credit card reward, and underlying welfare are impacted by a no-surcharge rule. When a no-surcharge rule is implemented, we find that the credit card merchant fee pass-through is often greater than the credit card reward to cardholders so that all consumers, credit card and cash, pay a higher effective price. If merchants can surcharge across payment methods, then all consumers pay the same effective price so that the credit card fails to garner usage.

In terms of welfare, we find that a no-surcharge rule always harms cash consumers, merchants, and cardholders on the margin of purchasing a credit card. In addition, the non-margin card holding consumers can also be harmed (depending on competition structures

[20]Furthermore, modeling competition between credit card companies has its difficulties. For example, Schwartz and Vincent (2020) find that pure strategy equilibria in credit card fees and rewards cannot exist because credit cards compete by trying to outdo each other's spread between the merchant fee and consumer reward. In contrast, Gerlach and Li (2021) provide an alternative framework to study competition between two vertically differentiated platforms, a high-quality high-cost platform (e.g., a premium credit card) facing a rival with lower quality and lower cost (e.g., a standard credit card), and show that total fees can be lower under the NSR because the two platforms are forced to compete for the entire sale of a merchant instead of being segmented under surcharging.

across markets and the credit card pricing strategy). In terms of the current policy debate, this suggests that the merchants' point is a valid one: protected premium fees are passed on to consumers creating a double marginalization effect that increases effective prices and reduces sales. This suggests that the Supreme Court ruling to prevent steering (i.e., surcharging) benefited premium credit card companies at the expense of consumers and merchants. However, our findings also imply that policy makers can rectify this mistake by preventing the "accept all cards" clauses that credit card companies utilize. Such a ruling would enable merchants to lower effective prices by limiting premium card purchases without losing sales to consumers using standard cards.

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Appendix of Proofs

Proof of Lemma 1: Merchant profits are independent across payment methods when surcharging is allowed. Thus, p_m^{cc} and p_m^c are given by Equations (2) and (3) so that $p_m^c = \frac{c_m+\theta_m}{1+\theta_m}$ and $p_m^{cc} = \frac{\theta_m}{(1+\theta_m)(1-r)} + \frac{c_m}{(1+\theta_m)(1-f)}$. Note that merchants prefer the credit card over cash when $(1-f)p_m^{cc} > p_m^c$ and cardholding consumers prefer the credit card over cash when $(1-r)p_m^{cc} < p_m^c$. Equations (5) and (6) imply that each condition holds if and only if $r > f$ so that consumers and merchants payment preferences are perfectly aligned when surcharging is allowed: if $f < r$, then both the merchants and the cardholders want the credit card to be used instead of cash, and so cardholders use their card and pay p_m^{cc} while cash consumers pay p_m^c; otherwise, if $f \geq r$, then all consumers use cash and pay p_m^c. $\square$

Proof of Lemma 2: First note that if $f = r$, then $p_m^c = (1-r)p_m^{cc}$ so that effective prices are the same and consumers are indifferent between using a credit card and cash. In this case, either every consumer purchases and uses a card (if $F = 0$) or no consumer does (if $F > 0$). Thus, if $f^S = r^S$, then the credit card company sets $F^S = 0$ so that $\lambda^S = 1$ and credit card profit is $\left[\int_0^1 (f - r - t)p_m^{cc} \cdot Q_m^{cc}(\lambda^S(r, f, F))\ dm\right] + \lambda^S(r, f, F) \cdot F = \int_0^1 (-t)p_m^{cc} \cdot Q_m^{cc}(1)\ dm$ which is greater than or equal to zero if and only if $t \leq 0$.

An alternative strategy that the credit card company may deviate toward is that they could set $f = r + b - \epsilon$ for $\epsilon > 0$ and $F > 0$ as a kind of two-part tariff, where $\epsilon > 0$ is injected into every market so that $p_m^c > (1-r)p_m^{cc}$ and this allows for an $F > 0$ that extracts rents. However, the reduction in transaction rents for the credit card company, captured by $\epsilon p_m^{cc}(f = r - \epsilon) \cdot Q_m^{cc}(\lambda^S(r, f, F))$, does not outweigh the consumer surplus that is created by such a deviation: $[p_m^c - (1-r)p_m^{cc}(f = r - \epsilon)] \cdot Q_m^{cc}(\lambda^S(r, f, F))$. To see this note that $\epsilon p_m^{cc} \cdot Q_m^{cc}(\lambda^S(r, f, F)) > [p_m^c - (1-r)p_m^{cc}(f = r - \epsilon)] \cdot Q_m^{cc}(\lambda^S(r, f, F))$ if and only if $\frac{1-r+\epsilon}{1-r}\theta_m - \theta_m > 0$ which holds for all $\epsilon > 0$ for all $m \in [0, 1]$. This implies that a deviation to $\epsilon > 0$ and $F > 0$ cannot earn greater profit. Thus, if $t \leq 0$, then $f^S = r^S$, $F^S = 0$, and $\lambda^S = 1$. Instead, if $t > 0$, then the credit card company is unable to earn profit so that

$r^S = f^S - t = F^S = 0$ and $\lambda^S = 0$ ensure that no agent deviates. $\square$

Proof of Lemma 3: The equilibrium price for the no-surcharge subgame is given by Equation (4). Solving for p with $Q^{cc} = \lambda[1-(1-r)p]$ and $Q^c = (1-\lambda)(1-p)$ implies that $p = \frac{(1-\lambda r)c+\theta\cdot(1-\lambda f)}{(1+\theta)[1-\lambda(r+f-rf)]}$. $\square$

Proof of Lemma 4: If merchants abide by a no-surcharge rule, then equilibrium credit card fees must be such that either $F^{NSR} > C$ or $f^{NSR} > r^{NSR} + t$; otherwise, credit card profit is negative. In addition, $\lambda^{NSR} \in (0,1]$, with $\lambda^{NSR} > 0$ so long as costs (C and t) are sufficiently low. Finally, Lemma 3 implies that

$$p_m^{NSR} = \frac{(1-\lambda^{NSR}r^{NSR})c_m + (1-\lambda^{NSR}f^{NSR})\theta_m}{(1+\theta_m)[1-\lambda^{NSR}(r^{NSR}+f^{NSR}-r^{NSR}f^{NSR})]},$$

which completes the proof. $\square$

Proof of Proposition 1: Equations (7) and (9) imply that $p_m^{NSR} > p_m^S$ if and only if $\frac{(1-\lambda^{NSR}r^{NSR})c_m+(1-\lambda^{NSR}f^{NSR})\theta_m}{(1+\theta_m)[1-\lambda^{NSR}(r^{NSR}+f^{NSR}-r^{NSR}f^{NSR})]} > \frac{c_m+\theta_m}{1+\theta_m}$. This holds if and only if $0 > -(1-r^{NSR})\lambda^{NSR}f^{NSR}c^{NSR} - (1-f^{NSR})\lambda^{NSR}f^{NSR}\theta_m$, which holds for all $\lambda^{NSR} > 0$, $0 < f^{NSR} < 1$, and $r^{NSR} < 1$. $\square$

Proof of Proposition 2: Equations (7) and (9) imply that $(1-r^{NSR})p_m^{NSR} > p_m^S$ if and only if $(1-r^{NSR}) \cdot \frac{(1-\lambda^{NSR}r^{NSR})c_m+(1-\lambda^{NSR}f^{NSR})\theta_m}{(1+\theta_m)[1-\lambda^{NSR}(r^{NSR}+f^{NSR}-r^{NSR}f^{NSR})]} > \frac{c_m+\theta_m}{1+\theta_m}$. This holds if and only if $0 > (r^{NSR} - \lambda^{NSR}f^{NSR} + \lambda^{NSR}r^{NSR}f^{NSR} - \lambda^{NSR}(r^{NSR})^2)c_m + (r^{NSR} - \lambda^{NSR}r^{NSR})\theta_m$, which holds whenever

$$\lambda^{NSR} > \frac{r^{NSR}(c_m+\theta_m)}{r^{NSR}\theta_m + f^{NSR}c_m - r^{NSR}f^{NSR}c_m + (r^{NSR})^2c_m} \equiv \overline{\lambda}.$$

Note that $\overline{\lambda} > 0$ since $r^{NSR}, f^{NSR} < 1$. Also, $\overline{\lambda} < 1$ if and only if $(f^{NSR} - r^{NSR})(1-r^{NSR}) > 0$ which holds since $f^{NSR} > r^{NSR}$. Thus, $\overline{\lambda} \in (0,1)$. Finally, note that $\frac{\partial\overline{\lambda}}{\partial\theta} > 0$ if and only if $(f^{NSR} - r^{NSR})(1-r^{NSR}) > 0$ which holds since $f^{NSR} > r^{NSR}$. $\square$

Proof of Proposition 3: If $F^{NSR} = 0$ and $1 > f^{NSR} > r^{NSR} > 0$, then Equation (1) is satisfied for every consumer since the right-hand side of Equation (1) is non-negative; hence,

$\lambda^{NSR} = 1$. In this case with $\lambda^{NSR} = 1$, Equations (7) and (9) imply that

$$(1 - r^{NSR})p_m^{NSR} = \frac{1 - r^{NSR}}{1 - f^{NSR}} \cdot \frac{c_m}{1 + \theta_m} + \frac{\theta_m}{1 + \theta_m} > \frac{c_m}{1 + \theta_m} + \frac{\theta_m}{1 + \theta_m} = p_m^S,$$

where the inequality holds since $1 > f^{NSR} > r^{NSR} > 0$. $\square$

Proof of Proposition 4: If $F^{NSR} > 0$, $1 > f^{NSR} > r^{NSR} > 0$, and $\lambda^{NSR} < \overline{\lambda}(\theta_m)$ for all $m \in [0, 1]$, then consider the marginal consumer given by (as shown following Lemma 3):

$$F^{NSR} = \int_{M_{\lambda^{NSR}}} r^{NSR} p_m^{NSR} dm := R(\lambda^{NSR}).$$

This marginal consumer $i = \lambda^{NSR}$ is indifferent between incurring the membership fee $F^{NSR} > 0$ to enjoy an effective retail price of $(1 - r^{NSR})p_m^{NSR}$ and simply paying p_m^{NSR} with cash. Thus, in terms of welfare, comparing p_m^{NSR} directly with p_m^S determines the regime that is best for the marginal consumer. From Proposition (1), $p_m^{NSR} > p_m^S$ for all θ_m which implies that the marginal consumer is worse off with the no-surcharge rule. In addition, the continuity in $R(\cdot)$ and the inequality in $p_m^{NSR} > p_m^S$ being strict imply that there exists an $\epsilon > 0$ so that every cardholder i with $i \in (\lambda^{NSR} - \epsilon, \lambda^{NSR})$ is worse off from the no-surcharge rule. $\square$