Vertical MFN's and the Credit Card No-surcharge Rule*

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1 Introduction

This paper presents a theory of vertical most favored nation clauses (MFNs) and then applies the theory to the credit card industry. A vertical MFN is a restraint that an upstream supplier imposes on a retailer that prevents the retailer from charging more for the supplier's product than for the products of rival suppliers.[1] In the market for credit card services, this restraint takes the form of a no-surcharge rule: that retailers not surcharge for purchases made with a particular credit card compared to purchases made with other credit cards, cash or debit. Vertical MFN's are observed in markets other than credit cards, such as tobacco, and holiday travel packages.

We investigate the impact of the vertical MFN restraint on competition among upstream suppliers selling through a common set of competing retailers. An upstream supplier faces many dimensions of competitive discipline against raising its wholesale price when merchants are free to surcharge. Two are likely to be most significant: the ability of consumers to choose another product as the wholesale price increase is reflected in a higher retail price; and the ability of retailers to drop the product. We start by setting aside the ability of retailers to

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[1] The restraint is sometimes known as a "price parity" restraint.

drop a product, by imposing a "must-carry" assumption on retailers so that each retailer carriers all products. This allows us to focus on the impact of the restraint on competition arising from consumer choice.[2]

Under the must-carry assumption, we consider the impact of the restraint within two market structures upstream: a symmetric, differentiated duopoly; and a monopoly facing a competitive fringe (again, producing differentiated products). In both cases the upstream firms face a competitive retail sector downstream.

In the duopoly model, under the must-carry assumption, equilibrium wholesale and retail prices rise above the Bertrand-Nash equilibrium price when both firms adopt the restraint. Consumers are unambiguously harmed. Retailers must charge the identical price for both products to meet the MFN constraints, which eliminates the ability of either firm to undercut its rival's retail price. Since wholesale prices rise under the restraint, supplier firms can obviously be better off. Surprisingly, however, suppliers may be worse off when both adopt the restraints. This is because of an externality unique to this restraint. When both firms adopt the restraint, an increase in the wholesale price by one supplier leads to an increase in the common retail price of both goods. Each supplier raises its wholesale price even beyond the joint profit-maximizing level, knowing that its customers bear less than the full impact of the price increase with the remainder being externalized to the consumers of its rival's product.[3] Depending on how much profit is lost as a result of this elevation of price above the joint profit maximizing price, it is possible for the suppliers to be worse off compared to the equilibrium that prevails when vertical MFNs are not adopted. Moreover (with linear demand) each supplier adopts the restraint as a dominant strategy. The possibility of this prisoners' dilemma means that prohibiting the restraint can be Pareto optimal, benefiting both consumers and suppliers.

In the model of monopoly with a competitive fringe, under the must-carry assumption the monopoly always profits from adopting a vertical MFN to extract surplus from consumers in the competitive sector. Consumers of the competitive good are always harmed by the vertical MFN. Where demand for the two goods is symmetric, the monopoly uses the vertical

[2]In our application, this assumption is that Visa and MasterCard, the two main credit cards, would continue to have close to 100 percent coverage with or without the no-surcharge restraint.

[3]We refer to this effect as the *cost-externalization* effect.

MFN to extract additional surplus from its own customers as well. On the other hand, if demand is asymmetric in the sense that the monopoly good is more price inelastic than the competitive good (as is realistic for our application to credit cards) then the price of the monopoly good falls with the MFN. The MFN then implements a transfer from the consumers of the competitive good to both the monopoly supplier and to consumers of the monopoly good. This translates in our application to the prediction that no-surcharge rules implement a transfer from cash customers to credit card customers.

The monopolist-competitive fringe model with the must-carry assumption can thus explain the incentives for the vertical MFN restraint. But in certain circumstances the model with the must carry assumption gives too much power to the monopolist. For example,in the model, even a monopolist that is small relative to the competitive fringe can leverage its monopoly power to capture the entire monopoly profits across both sectors. (It is the monopolist's position as supplying a must-carry product that gives it the power to collect the entire industry profits.) Accordingly, we investigate the incentives for the MFN in the monopoly-competitive fringe model when the must-carry assumption is relaxed.

Endogenizing retailers' choices of which products to carry in this way limits the profitability of the MFN restraint. In fact, the MFN is not profitable at all if we retain the structure of a perfectly competitive retail market downstream. In other words, to explain MFN restraints on retailers, once must-carry is relaxed, we must introduce retailer differentiation and market power downstream.[4] We therefore adopt a setting to incorporate retailer market power. This leaves us with our final model for assessing the impact of a vertical MFN: a monopoly and fringe producing differentiated products upstream; differentiated duopoly retailers downstream. We ask within this framework whether an MFN can profitably leverage monopoly power, and whether the full leverage – to monopoly prices of both products – is possible. Full leverage is feasible under ideal conditions (including perfect symmetry of demand). But full leverage is never optimal: a higher price by the monopolist

[4]A logical alternative is that consumers are not perfectly informed as to their preferences. In a forthcoming paper, we develop a model with competitive retailers assuming that consumers engage in one-stop shoppping. In that model, there is no need for retailer market power. The results of that model are broadly consistent with the results of the models we present here.

in this framework requires that a greater share of industry profits be left with retailers if each retailer is to adopt the MFN contract. This disciplines pricing under the MFN and can deter the monpolist from even adopting the restraint. The MFN, and the partial leverage of monopoly power that results, are profitable for some parameters of a linear-demand version of the model, but not for all parameters.

The bottom line of our models: where one supplier has market power, consumers of at least the competitive product, and possibly all consumers, are harmed by the vertical restraint. Where multiple suppliers have market power, even the suppliers themselves may be harmed by the restraint.

We apply our theory of vertical MFNs to the no-surcharge rule in the market for credit card services. Credit card services are provided through the joint efforts of the credit card company, the banks that issue credit cards to consumers (the "issuers"), and in a more limited way the merchants' banks. Merchants pay a fee for the right to accept a credit card as a payment mechanism for their retail products; the fee can be passed through in the form of a surcharge for purchases with the credit card, in the absence of a no-surcharge rule.

The range of public policies on no-surcharge rules is huge. In the European Union, surcharges are allowed but have been limited since March 2015.[5]Canadian competition authorities challenged no-surcharge rules, unsuccessfully, in 2010.[6] The U.S. Department of Justice reached an agreement with Visa and MasterCard in 2010 that disallowed credit card restraints against various means of merchant "steering" a customer from one credit card or method of transaction to another.[7] But the agreement explicitly allowed no-surcharge rules, subject to some conditions.[8] In other words, the agreement ruled out vertical re-

[5]http://europa.eu/rapid/press-release_IP-15-4585_en.htm

[6]*The Commissioner of Competition v. Visa Canada Corporation and MasterCard International Incorporated*, 2013 Comp. Trib. 10. Carlton and Winter appeared as experts for the Canadian Competition Bureau in this case.

[7]Subsequently, the DOJ prevailed in a case against American Express that extended the conditions of the agreement with Visa and MasterCard to American Express as well.

[8]"Visa/MasterCard may contract with merchants not to surcharge: Nothing in the settlement proposal prohibits Visa/MasterCard from contracting with merchants not to surcharge if: the agreement is for a fixed duration; the agreement is not subject to an evergreen clause; the agreement is individually negotiated with the merchant or a group of merchants organized pursuant to the proposed settlement and other applicable law; and the agreement is supported by independent consideration." Summary of Proposed Settlement in Visa/MasterCard Antitrust Litigation, U.S. Department of Justice, 2010.

straints against steering via persuasion or promotions but allowed vertical restraints against merchants' use of the price mechanism, the most direct method of influencing consumers' choices. At the state level in the U.S., many states not only allow no-surcharge rules but insist on them, enforcing no-surcharge rules as a matter of law. In short, the range in policies on this vertical restraint stretches from laws that rule out vertical restraints *against* surcharging to laws that *impose* no-surcharging restraints.

Our theory of vertical MFNs applies directly to the no-surcharge rule. Our vertical MFN theory in the duopoly setting implies that the no-surcharge rule not only suppresses competition between two credit card companies, but raises the prices charged to merchants for using credit cards to a level higher than the joint monopoly price. Our vertical MFN theory in the monopoly-competitive fringe setting applies directly to markets in which a credit card company faces cash (or debit) as a competitive alternative. Here the model implies that the no-surcharge rule allows a credit card company effectively to extract a tax from cash customers. Higher credit card charges to the merchant under the no-surcharge restraint are reflected in higher product prices generally, not just in higher charges for credit card purchases.

The "wholesale price" for credit card services that merchants pay, through their banks, to the upstream suppliers consists of several parts. The main component is a fee referred to the *interchange fee paid* to the issuer; another component is the network fee that ultimately goes to the credit card company (e.g., Visa); a final component is a small fee that the merchant's bank keeps to cover its costs and profits. The interchange fee is for representative values of fees 90 percent of the wholesale price. Interpreting the interchange fee as a price within a conventional, vertical setting is contentious in the policy literature on credit cards. The literature on credit card economics is replete with warnings that the interchange fee is "not a price" but rather a means of balancing the two sides of the credit card market: cardholders and merchants. The interchange fee, set by the credit card company, is a transfer from the merchant side of the market to the issuer/cardholder side of the market that is intended to incentivize the issuer to provide cardholder benefits, promotion and general sales effort. The interchange fee will always be chosen, *ceteris paribus*, to maximize volume of transactions, balancing at the margin the quantity effects of a transfer between the two sides.

The credit card literature contends that conventional vertical "single-sided market" theories such as ours cannot be applied to this two-sided market. A theory that the merchant fee (largely the interchange fee) is raised by suppressing competition has no policy implications without considering the impact on issuer incentives on the other side of the market. We set out the economic parallels between a conventional single-sided market and the two-sided credit card markets. The balancing of the two sides of a two-sided market is equivalent to the balancing of price and promotion in a conventional market, as captured in the Dorfman-Steiner theorem. Defending a practice that raises merchant fees for credit cards on the basis of the positive impact that the practice will have on the other side of the market is equivalent to defending in a conventional market the suppression of price competition on the basis that it will inspire greater non-price competition, or sales effort, leading to increased sales. We find the defence of a no-surcharge rule unpersuasive in the case of credit cards. Instead, we think that any increased sales effort resulting from the use of the no surcharge rule is the predictable consequence of having an anticompetitive elevation of price, a result that is well-known and appeared at least as early as Stigler (1964). Stigler showed that the suppression of price competition leads to an increase in non-price competition.

Our model is the simplest possible model to capture the anticompetitive impact of no-surcharge rules. The papers in the sizable literature on credit card economics that are closest to ours, in that they consider no-surcharge rules, are Rochet and Tirole (2002), Wright (2003), and Schwartz and Vincent (2006). These papers incorporate, variously, market power on the part of issuers and market power in the form of a differentiated duopoly or monopoly at the retail level, in addition to the market power on the part of the (single) credit card company. And the papers deal with consumers' decisions to adopt cards, merchants' decisions to honor cards, merchants' decisions to surcharge as well as the decision to impose no-surcharge rules.[9] Our vertical MFN model is more focused. It incorporates for the most part market power only for providers of this service – and then introduces market power for downstream retailers only when this is necessary to explain MFNs. [10]An important paper Boik and Corts (2014) ("BC") investigates the effects of price parity rules imposed by platforms on which buyers

[9]Schwartz and Vincent have an exogenous partition of customers into cash and credit card customers.

[10]Retailer differentiation is necessary to explain MFN's, as discussed above, when the must-carry assumption is relaxed.

and sellers can transact. A price parity rule in their model is a restriction by a platform imposed on suppliers that the price of a product not be lower on any other platform. There is a formal parallel between the BC theory and our duopoly model, although these authors do not apply their theory to credit cards and do not have a competitive retail sector. [11]

Section 2 below develops the general model of vertical MFN's, for both the duopoly and monopoly/competitive fringe cases. Section 3 sets out the cash flows of a credit card network, then compares our vertical perspective with the two-sided market perspective on credit cards, the role of the interchange fee in particular. The section concludes with a discussion of our view that the no-surcharge rule harms competition.

2 The Economics of Vertical MFN's

We analyze a vertical MFN in both a duopoly setting and a monopoly-competitive fringe setting. To motivate the specification of the general model, note that in our application to credit cards, a credit card company faces various sources of competitive discipline against increasing fees to merchants. (We refer to a setting where merchant fees can be passed on to consumers through surcharges.) These are:

- Consumers at the point of sale can switch to another card, or to cash or debit when a higher merchant fee is pass through to consumers in the form of a higher surcharge for using a particular card. Most consumers who use credit cards carry more than one.

- Merchants are free to refuse to accept a credit card. Alternatively, if merchants do not want to forgo the business of those who insist on using a particular card, they can encourage the use of a different card or cash;

[11] The most important formal difference between the BC model and our duopoly model is that we assume a competitive retail market. This leaves us with a duopoly model in which the only firms with market power are the credit card companies, allowing us to focus on the strategic behavior of these firms. Boik and Corts, on the other hand, assume in addition a monopoly supplier (equivalent to a monopoly merchant in our setting). This leaves them with a rich but much more complex model. Our duopoly model is the simplest formalization of the theory offered by Winter (2012) in his testimony that the no-surcharge rule raises credit card charges through the suppression of competition between credit card companies and the cost-externalization effect.

- Consumers can choose to shop at a different store;
- Consumers can forgo or reduce the purchase of a final product if its price rises, as would occur it becomes more costly to transact;
- Consumers can decide not to carry the company's credit card.

Of these the first two are likely to be the most significant. And the first is surely a much stronger source of demand elasticity in practice since when a surcharge increases it is easy for a consumer to switch credit cards to purchase the identical good at a lower price. Accordingly, in developing the general model of vertical MFN's we focus for the most part on the impact of the vertical MFN on competition arising from the ability of consumers to switch products; we initially suppress the second source of demand elasticity entirely by assuming that retailers must carry the products being considered. We then relax the must-carry assumption for the monopoly - competitive fringe case.

2.1 Duopoly

2.1.1 Assumptions

Two upstream suppliers each provide a differentiated product to consumers through a common set of retailers. The suppliers produce at unit cost c and charge wholesale prices (w_1, w_2) to retailers, where the index refers to supplier 1 or 2. Retailers face no costs other than the wholesale price. The retail market is competitive, which implies that retailers earn zero profits. Demand functions for the two products are $q_1(p_1, p_2)$ and $q_2(p_1, p_2)$. These demand curves are assumed to satisfy standard conditions for uniqueness of equilibrium in Bertrand competition and for profitability of profit functions.These standard conditions include the inequality $\partial q_1/\partial p_2 < -\partial q_1/\partial p_1$. The demand functions are also assumed to be symmetric.

As discussed above, we set aside the option of retailers to drop a product, adopting a "must-carry" assumption.

We consider the following game. The two upstream suppliers decide simultaneously whether to adopt an MFN. Then these suppliers set wholesale prices. The retailers simultaneously set a pair of retail prices for the two products subject to any vertical restraint on prices. Finally, the retail market clears.

2.1.2 Equilibrium

Consider first the retail market equilibrium conditional upon the choices of MFN (or not) by the upstream suppliers and wholesale prices (w_1, w_2). If neither supplier imposes an MFN, then competitive retailers simply pass on wholesale prices as retail prices, $(p_1, p_2) = (w_1, w_2)$, where the retail price of good i is p_i, for $i = 1, 2$. If the MFN restraint is imposed by *both* suppliers, then – given the symmetry in demand - the retail price equals $(w_1 + w_2)/2$, since this is the uniform price that yields zero price. Suppose that only one supplier sets an MFN. Then given the pair of wholesale prices (w_1, w_2) if the supplier imposing the MFN restraint is the one with the lower wholesale price the constraint is not binding and therefore irrelevant. The retailers set $(p_1, p_2) = (w_1, w_2)$. On the other hand, if the supplier imposing the MFN restraint is the higher priced firm then the common retailer price for both goods is $p = (w_1 + w_2)/2$. In short, if the higher-price supplier has not imposed an MFN, the retail prices are $(p_1, p_2) = (w_1, w_2)$; if the higher-price supplier has imposed an MFN, the retail price is $p = (w_1 + w_2)/2$.

We move next to the wholesale pricing game, conditional upon the supplier choices on MFN's. Let the wholesale pricing subgames be indexed by $(0, 0), (1, 1), (1, 0)$ and $(0, 1)$ depending on whether neither, both, or one of the suppliers has adopted the MFN restraint. We start by comparing the $(0, 0)$ pricing subgame with the $(1, 1)$ subgame, then move on to solving the entire game.

2.1.3 The $(0, 0)$ Pricing Subgame:

The $(0, 0)$ pricing subgame is simply the Bertrand game. The Bertrand wholesale price (and retail price) common to both products is the price w_B that solves the following equation

$$w_B = \arg\max_{w_1} (w_1 - c) q_1(w_1, w_B)$$

The first-order condition characterizing w_B is standard:

$$(w - c) \frac{\partial q_1}{\partial p_1}(w, w) + q_1(w, w) = 0 \tag{1}$$

2.1.4 The $(1,1)$ Pricing Subgame:

In the $(1,1)$ subgame, following the adoption of the restraint by both firms, the profit function of supplier 1 (incorporating downstream retailer equilibrium responses) is given by

$$\pi_1(w_1, w_2) = (w_1 - c)q_1\left(\frac{(w_1+w_2)}{2}, \frac{(w_1+w_2)}{2}\right)$$

The equilibrium wholesale price, which is then the common retail price, solves the following

$$w = \arg\max_{w_1}(w_1 - c)q\left(\frac{(w_1+w)}{2}, \frac{(w_1+w)}{2}\right)$$

This yields the following first-order condition (evaluated at a common wholesale price w) :

$$(w-c)[\frac{1}{2}\frac{\partial q_1}{\partial p_1}(w,w) + \frac{1}{2}\frac{\partial q_1}{\partial p_2}(w,w)] + q_1(w,w) = 0 \tag{2}$$

2.1.5 Comparing the equilibria in the $(0,0)$ and $(1,1)$ pricing subgames:

We assess the competitive impact of the MFN, when imposed by both suppliers, in two ways. First, we measure the strength of the incentive that each supplier has to raise price starting from the Bertrand equilibrium of the $(0,0)$ pricing subgame. Letting $\pi^{11}1(w_1, w_2)$, be the payoff to supplier 1 in the $(1,1)$ subgame, this incentive is $\partial\pi_1^{11}/\partial w_1$, evaluated at Bertrand equilibrium (w^0, w^0) of the $(0,0)$ game.

This measure is akin to measuring the *upward pricing pressure* (UPP) induced by the restraint, to use Farrell and Shapiro's (2010) term. Farrell and Shapiro use the UPP to assess the strength of incentives for price increases caused by mergers. The same concept applies to the strength of pricing incentives induced by the MFN vertical restraint. (Farrell and Shapiro normalize the merged firm's profit derivative by dividing by $\partial q_1/\partial w_1$; we skip this normalization.)

In addition to this local, UPP-type measure of the impact of the restraint on pricing incentives, we evaluate the full impact of the restraint on the equilibrium price.

Subtracting the left-hand side of (1) from that of (2) yields

$$\frac{\partial\pi_1^{11}}{\partial w_1}\rfloor_{(w^0,w^0)} = \overbrace{(w^0-c)(-\frac{1}{2}\frac{\partial q_1}{\partial p_1})}^{\text{cost-externalization effect}} + \overbrace{(w^0-c)(\frac{1}{2}\frac{\partial q_1}{\partial p_2})}^{\text{diversion effect}} > 0 \tag{3}$$

Both of the effects in (3) are positive, demonstrating that price is raised by the MFN agreements. The *cost-externalization effect* is the benefit from raising wholesale price that accrues to a supplier from the fact that retailers pass on only half of any upstream price increase to purchases of the upstream firm's product. Half the cost is externalized through an increase in the retail price of the other good. And the *diversion effect* is the benefit that the supplier gains from the fact that raising its price automatically raises the price of its rival, causing a diversion of demand towards its own product. Both of these effects operate to raise a firm's marginal gain from raising the wholesale price. Hence, both wholesale prices increase as a result of the vertical restraint.

We can compare the upward pricing pressure from the joint adoption of the MFN restraint with the upward pricing pressure from full collusion[12]. Let the joint profits of the two suppliers be $\tilde{\pi}(w_1, w_2) = (w_1 - c)q_1(w_1, w_2) + (w_2 - c)q_2(w_1, w_2)$. The marginal impact on joint profits of an increase in w_1 is, in general:

$$\frac{\partial \tilde{\pi}}{\partial w_1} = (w_1 - c)(\left(\frac{\partial q_1}{\partial p_1}\right)) + q_1 + (w_2 - c)(\left(\frac{\partial q_2}{\partial p_1}\right)) \tag{4}$$

Subtracting the Bertrand first-order condition (1) from (4) yields a standard expression the incentive that colluding firms would have to raise price above the pre-MFN levels:

$$\frac{\partial \tilde{\pi}}{\partial w_1}\rfloor_{(w^0, w^0)} = (w^0 - c)(\left(\frac{\partial q_2}{\partial p_1}\right)) > 0 \tag{5}$$

Comparing this to equation (3) and using the fact that $\frac{\partial q_2}{\partial p_1} < -\frac{\partial q_1}{\partial p_1}$ yields a sharp result. By our local, UPP-type measure, the MFN is even more anti-competitive than full collusion:

Proposition 1 *If both suppliers have adopted a vertical MFN, then the incentive for either to raise its price above the no-MFN equilibrium level is greater than that resulting from full collusion.*

The diversion effect, naturally, depends on the cross-elasticity of demand. But the cost-externalization effect does not. Even two firms selling completely independent products through the same set of retailers are induced to raise price by the MFN. Since these firms

[12] By "full colllusion", we mean joint profit maximization.

would set price to maximize collective profit in the absence of any MFN agreements, this means that the situation of both firms signing the MFN is potentially harmful not just to consumers but to the firms themselves.

To move from the assessment of local competitive pressures on price to an evaluation of the full impact on equilibrium price, we evaluate the derivative $\partial\pi^{11}/\partial w_1$ not at the Bertrand price but at the fully collusive price, w^*. We can do this by subtracting the collusive first-order condition (4) from the first-order condition (2) on w_1 in the $(1, 1)$ game. This yields

$$\frac{\partial \pi_1^{11}}{\partial w_1}\rfloor_{(w^*,w^*)} = \frac{1}{2}(w^* - c)\left[-\frac{\partial q_1}{\partial p_1} - \frac{\partial q_2}{\partial p_1}\right] > 0 \tag{6}$$

Given the concavity assumption on profits, this demonstrates the following.

Proposition 2 *The equilibrium wholesale price in the* $(1, 1)$ *game exceeds the collusive price.*

The move to a higher price than the fully collusive price under MFN can be understood in terms of a switch from substitute products to complements. Under the MFN restraint, the products 1 and 2 become *complements* in terms of the wholesale prices (w_1, w_2) rather than substitutes: an increase in the price w_1 leads to a drop in q_2 since firm 2 's retail price increases. (The equal increase in firm 1 's retail price raises demand for firm 2 's product but not by enough to offset the own-price effect.) Non-cooperative prices set by producers of complementary products always exceed the collusive price, just as non-cooperative prices set by producers of substitutes are less that the collusive price.

Since the firms continue to compete in prices, rather than quantities, the move to complements in the $(1, 1)$ game is a move (when demand is linear) not just from substitutes to complements but a move to prices as *strategic substitutes*. This is in contrast to the relationship of strategic complements in the $(0, 0)$ game.[13] Under the MFN reaction curves are downward sloping, in other words: the greater a rival's wholesale price (and, therefore, the greater the common retail price), the less inclined a firm is to raise the common retail price

[13]Taking the case of linear demand, $q_1(p_1, p_2) = 1 - p_1 + dp_2$, the profit function for firm 1 becomes

$$\pi_1 = (w_1 - c)[1 - (1 - d)(\frac{w_1 + w_2}{2})]$$

From this, $\partial^2\pi_1/\partial w_1\partial w_2 = -(1 - d)/2 < 0$, demonstrating strategic complementarity.

even further through an increase in its own price. Figure 1 compares the subgame pricing equilibria of the $(0,0)$ Bertrand game and the $(1,1)$ MFN game for the case of linear demand.

It follows immediately from Proposition 2 that the adoption of the MFN by both firms makes consumers worse off by raising each retail price. Firms are worse off than they would be under full collusion, and if the products are only distant substitutes or independent, firms are worse off than under the no-MFN equilibrium.

We next point out an obvious but important fact about the vertical restraint in this model.

Proposition 3 *Under our assumption of symmetry, the vertical MFN restraint is not binding on any retailer in equilibrium.*

In assessing the importance of a vertical restraint in reality, it is tempting to think of this as being measured by the extent to which it constrains retailer actions. A restraint that has little impact on retailer decisions would seem to have little impact in the market. This reasoning is wrong. The MFN restraint is not binding at all on equilibrium retailer decisions. Its impact on the market is entirely through the constraint on retailer pricing *out-of-equilibrium*: the impact that the restraint *would* have if wholesale prices were unequal. An implication of this observation is that one should not rely on retailer testimony that the MFN restraint is not important, in deciding whether to pursue the restraint as anticompetitive.

For policy analysis of the vertical MFN restraint in a duopoly market in which both firms are observed to have adopted retail MFN's, the comparison of the $(1,1)$ and the $(0,0)$ subgames is enough to conclude that the vertical MFN harms consumers. The move from the $(1,1)$equilibrium to the $(0,0)$ equilibrium could be induced by a prohibition of the rvertical MFN. Any other subgame, and the complete game, are strictly speaking irelevant. To complete the positive theory of the restraint, however, we need to solve the entire game. This proceeds first with the equilibrium of the $(1,0)$ pricing subgame.

2.1.6 The $(1,0)$ Pricing Subgame

Recall that the MFN constraint is binding only when imposed by the higher-priced firm.When firm 1 alone has adopted the MFN restraint, then its reaction curve is therefore discontinuous: at low values of w_2 firm 1's best response is $w_1 > w_2$, which puts it on the MFN reaction curve of Figure 1. Above some value $\widehat{w}_2$, however, it pays firm 1 to undercut w_2. This moves firm 1 from its $(1,1)$-subgame reaction curve to its $(0,0)$ Bertrand reaction curve. Not surprisingly, given this discontinuous reaction curve, the $(1,0)$ pricing subgame has only a mixed strategy equilibrium, as in Boik and Courts (2014). In the appendix, we solve the equilibrium for this pricing subgame, and for the entire game, for the case of symmetric linear demand. Through appropriate choice of units, the linear demand system can be represented in completely general form as the following, with the only parameter being the cross-derivative, $d \in (0,1)$:[14]

$$q_1(p_1, p_2) = 1 - p_1 + dp_2$$
$$q_2(p_1, p_2) = 1 - p_2 + dp_1$$

The mixed-strategy equilibrium of the $(1,0)$ pricing subgame is the simplest possible kind of mixed strategy equilbrium. Firm 2 chooses a pure strategy equal to $\widehat{w}_2$, the value that renders firm 1 indifferent between reacting with a value w_a on its Bertrand reaction curve and a value w_b on its $(1,1)$ -game reaction curve. Firm 1 mixes between w_a and w_b with probabilities that make $\widehat{w}_2$ firm 2's best response.

2.1.7 The Entire Game

We know that when the cross-elasticity of demand is small the suppliers are worse off by jointly adopting the MFN restraint. The price is close to the joint-profit maximizing level without the restraint, and therefore the restraint increases prices above the joint profit-maximizing level to the detriment of the suppliers. It might be supposed that suppliers would therefore not adopt the practice. But the adoption of the restraint is an individual decision not a joint decision. In the case of linear demand we have the following. (All omitted proofs are in the appendix.)

Proposition 4 *With linear demand, adoption of the restraint is a dominant strategy by both firms in the first stage of the game. For* $d \in (0, \frac{1}{2})$*, the firms are worse off with the joint adoption of the restraint.*

[14]The units of measurement of quantities and currency can always be chosen so that the demand intercept and coefficient on own price are equal to 1 .

The prospect of extracting a transfer from the rival through the cost-externalization effect drives the incentive to adopt the MFN starting from a $(0,0)$ subgame. But the $(1,0)$ pair of decisions is not an equilibrium because the non-MFN firm does better by matching the MFN adoption. Adopting MFN is a dominant strategy. Yet firms are worse off when the cross-elasticity of demand is low: the firms are in a prisoner's dilemma. They cannot resist, in this static model, the temptation of adopting the dominant strategy. For more competitive firms, with $d \in (\frac{1}{2}, 1)$, the firms are better off with MFN because the advantages of avoiding intense Bertrand competition more than offset the costs of excessive pricing.[15]

That suppliers can get stuck in a Prisoners' Dilemma with a decision as simple as whether to adopt a vertical restraint is the result of the assumption of a static game. In a dynamic game, it is possible that the suppliers will recognize their interdependence and wind up at the joint profit maximization. Another solution to avoid the Prisoner's Dilemna is for the suppliers to lobby for a law that prohibits the use of vertival MFNs..

2.2 Monopoly Supplier and Competitive Fringe

We move next to the impact of a vertical MFN when the supplier considering the restraint is a monopolist producing one good facing a competitive fringe producing a substitute good.[16] This market structure is essential for the application of the theory to the no-surcharge restraint on credit cards in markets where some purchases are from cash (or debit) customers. Cash purchases are analogous to a competitive fringe alternative to credit card services.

2.2.1 Assumptions

A single firm supplies product 1 and considers a vertical MFN. A set of competitive firms provides product 2, which is an imperfect substitute for product 1. Consumers demands for the two products are $q^1(p_1, p_2)$ and $q^2(p_1, p_2)$, which again satisfy the assumption of yielding concave profit functions. The cost of producing product 1 is c and the competitive good is available at zero cost.

[15] In a real market, we would expect firms to be able to sustain the $(0,0)$ equilibrium if that were preferred to the $(1,1)$ equilibrium as part of a dynamic supergame equilibrium.

[16] The term "competitive fringe" is normally used in models where the competitive firms and the monopolist produce the same good. Here the firms are in the same market with differentiated goods.

The retail market is unchanged from the model of the previous section. Retailers *must carry* both products and consumers are fully informed. This again yields a retail equilibrium prices $(p_1, p_2) = (w, 0)$ in the absence of an MFN, and the lowest common retail price p that yields zero profits if an MFN is imposed.

The game is now simply a decision problem, since the monopolist is the only strategic player. The monopolist offers the optimal contract to retailers, which consists of a wholesale price, w, and possibly a vertical MFN restraint that $p_1 \leq p_2$.

2.2.2 The Incentives for a vertical MFN

The profit that a monopolist earns in this model from any contract is equal to the total industry profits achieved under the contract: since all other firms, upstream and downstream, are competitive the entire industry profits accrue to the monopolist. And these profits are a function of the retail prices achieved under the contract:

$$\Pi(p_1, p_2) = (p_1 - c)q^1(p_1, p_2) + p_2 q^2(p_1, p_2) \tag{7}$$

Thus we can view the wholesale price as an *instrument* with which to achieve optimal *target*, here (p_1, p_2), an approach followed in some of the vertical restraints literature. Within this framework, the monopolist's decision in offering a vertical restraint is a choice between two constraints on the target space: maximizing $\Pi(p_1, p_2)$ subject to $p_1 = p_2$ (a vertical MFN restraint) or maximizing $\Pi(p_1, p_2)$ subject to $p_1 = 0$ (no restraint).

Proposition 5 *Under the monopoly-competitive fringe assumptions, a vertical MFN is always profitable.*

To prove this proposition, start by splitting $\Pi(p_1, p_2)$ into the profits accruing from the sale of each good: $\Pi^1(p_1, p_2) = (p_1 - c)q_1(p_1, p_2)$ and $\Pi^2(p_1, p_2) = p_2 q_2(p_1, p_2)$ so that $\Pi = \Pi^1 + \Pi^2$. Let $(p^*, 0)$ be the optimal target under the no-MFN constraint $p_2 = 0$. The target (p^*, p^*) is achievable with an MFN and is more profitable than $(p^*, 0)$: $\Pi^1(p^*, p^*) > \Pi^1(p^*, 0)$ since the $q_{12} > 0$ and $\Pi^2(p^*, p^*) > \Pi^2(p^*, 0) = 0$.

In the case where the demand system is symmetric, we have:

Proposition 6 *If demand is symmetric in the monopoly - competitive fringe model, an MFN achieves the maximum industry profits. The MFN more than doubles profit.*

The MFN achieves the maximum industry profits because the MFN constraint (p_1, p_2) is not binding when demand is symmetric. We have $\Pi(p^*, p^*) = 2\Pi^1(p^*, p^*) > 2\Pi^1(p^*, 0) = 2 \max_p \Pi(p, 0)$. Thus imposing the MFN and leaving the retail price of good 1 unchanged (which would be implemented by doubling w) more than doubles profit.

Symmetry of demand is not necessary for the use of MFN to extract first-best industry profits, as the next proposition shows:

Proposition 7 *Suppose that the products are independent in demand, and for some function $\hat{q}(p)$, $q_1(p_1, p_2) = a\hat{q}(p_1)$ and $q_2(p_1, p_2) = \hat{q}(p_2)$, for $a > 0$. Then the vertical MFN allows the monopolist to obtain first-best industry profits.*

No matter how small a, under the hypothesis of the proposition, the monopolist can use the MFN to leverage its monopoly power perfectly from its own small submarket to the entire market. The proposition follows from the fact that the demands in the two markets have identical elasticities at any price, so the MFN constraint $p_1 = p_2$ is not binding in maximizing Π.

This proposition demonstrates the power of the must-carry condition in giving the monopolist market power – power that cannot be fully exploited through price setting alone, but is exploited through the complete leveraging of monopoly power via the MFN.

Having established the incentive for a vertical MFN under the monopoly-competitive fringe assumptions, we examine the impact of the MFN on equilibrium prices.

2.2.3 The Impact of the vertical MFN

By way of motivation, consider the case where the consumers of the two goods are distinct. The competitive good customers are invariably harmed as the price of their good rises. It might appear that the monopolist's consumers are better off under the MFN because under symmetry of demands only half of any wholesale price w is passed on. In fact, under a standard assumption, the price of each product rises. Assume that Π is concave and that $\Pi(p_1, p_2)$ is supermodular, i.e., that the cross-partial derivative $\Pi_{12} > 0$. [17] To investigate the impact of the MFN on p_1, note that the first-order conditions for the optimal price under no-MFN implies $\Pi_1^1(p^*, 0) = 0$. (Subscripts refer to derivatives evaluated at the given arguments.) The marginal impact on profit of an increase in price, starting from p^*, is:

$$\frac{d\Pi(p,p)}{dp}\rfloor_{p=p^*} = 2\frac{d\Pi^1(p,p)}{dp}\rfloor_{p=p^*} \tag{8}$$

$$= 2\Pi_1^1(p^*, p^*) + 2\Pi_2^1(p^*, p^*) = 2[\Pi_1^1(p^*, 0) + \int_0^{p^*} \Pi_{12}(p^*, s)ds + \Pi_2^1(p^*, p^*)] \tag{9}$$

Of the three terms inside the square bracket, the first term is zero by the first-order condition defining p^* as the optimal non-MFN price; the integral is positive by the assumption of supermodularity; and the last term is positive because the goods are substitutes. Thus, there is an incentive to raise price above p^* under the MFN. In summary,

Proposition 8 *In the case where demands are symmetric, if* Π *is concave and supermodular, then the prices of both goods rise when MFN is imposed.*

With asymmetric demand, the price to consumers of the monopoly good may decrease when the MFN is imposed, as the example in the following proposition shows.

Proposition 9 *Suppose that the demand for the two products is separable and that the elasticity of demand is greater for the competitive good at any price. Then the price of the monopoly good falls with the adoption of the MFN restraint.*

In our application the natural assumption will be that demand for the competitive good is more elastic. This proposition follows from simple application of the Lerner equation. It implies that with a more elastic demand for the competitive good, an MFN represents a transfer from competitive good consumers (cash consumers in our application) to both suppliers of the monopoly good (credit card services in our example) and consumers of that good.

[17] The supermodularity assumption is equivalent to the assumption that if Π^1 and Π^2 accrued to separate, competing agents, the resulting Bertrand game would have upward sloping reaction functions. Linear demand satisfies the assumptions of supermodularity and concavity.

2.3 Endogenizing retailers' decisions to carry the products

To this point, the monopoly-competitive fringe model has focused on the role of the MFN in leveraging monopoly power from the monopolized good to the competitive sector, suppressing the main dimension of competitive discipline: the ability of consumers to switch to another product. The model offers a theory of the incentives for the vertical MFN. But in certain circumstances the model with the must-carry assumption gives too much power to the monopolist. For example, in the model a monopolist with just a tiny share compared to the competitive fringe can leverage its monopoly position as a must-carry product to extract the full industry profits. This motivates us to examine the consequences of the second dimension of competitive discipline (among the five listed at the outset of this section): the ability of retailers to drop the product when a firm imposes an MFN (along with a large increase in the wholesale price that the MFN entails).

Our point here is that the disciplining power of this competitive option presents a strong limitation on the profitability of the vertical MFN restraint. The first observation is that if the market is perfectly competitive, then the option eliminates entirely the incentive for the MFN.

Proposition 10 *In the monopoly - competitive fringe model, if the must-carry assumption is relaxed, the incentive for a vertical MFN disappears.*

The proposition is clear.To increase profit from the optimal no-MFN strategy, the monopolist must extract profits from a higher price in the competitive sector, since it is already extracting maximum monopoly profits over its own product. But any attempt to raise price of the competitive product would lead to entry of competitive retailers selling only that product at a lower price. Consumers in equilibrium always have the option of buying the competitive good at cost.

Thus a monopoly-fringe model with a perfectly competitive retail market and with retailers' having the ability to drop the product cannot explain vertical MFN's. We explore below the incentive for a monopolist to leverage vertical MFN's in a model that recognizes retailer differentiation and retailer market power.

2.3.1 Assumptions

We retain the assumptions from the previous model, except for the must-carry assumption. A single firm supplies product 1 and considers imposing a vertical MFN on its retailers. A set of competitive firms provides product 2, which is an imperfect substitute for product 1. The cost of producing product 1 is c and the competitive good is available at zero cost.

Downstream, two retailers compete as differentiated duopolists. Denote the price of product i from retailer j by p_{ij}, and let $p = [p_{11}, p_{21}; p_{12}, p_{22}]$. The demand for good i from retailer j is denoted by $q_{ij}(p)$. Demand is perfectly symmetric, both upstream and downstream.

The monopolist's contract offered to each retailer j includes a two part price,[18] (w, F), and possibly a vertical MFN contract, $p_{1j} \leq p_{2j}$. We consider the following game:

1. The monopolist offers a contract to each retailer;

2. The retailers simultaneously decide whether to accept the contract offers. (A contract without an MFN is always accepted.);

3. Retailers set prices. A retailer that has accepted a non-MFN contract sets prices for both goods; a retailer that has accepted an MFN contract sets a common price for both goods; and a retailer that has rejected an MFN contract carries only the competitive product and sets the price for that product.

4. Given the retailers' decisions on prices and selection of products, the markets clear.

2.3.2 Equilibrium

Lemma 1 *Under the assumptions listed, a monopolist can offer an MFN contract that will elicit the price, p^*, that maximizes industry profits.*

Total industry profits can be expressed as a function $\Pi(p)$. Under the symmetry assumptions, industry profits are maximized by a price p^* for both goods at both retailers; the maximum industry profits are realized when p^* is established by both retailers for both products. The manufacturer simply sets w under an MFN contract to the level that ensures

[18] Retailers in this model can earn positive profits, in contrast to our previous models. A fixed fee allows the monopolist to extract some of the profits. In our forthcoming paper, we work out a model with competitive retailers and endogenous choice of products to carry with results similar to those reported here.

each retailer's best response to p^* on the part of the rival retailer is p^*. That is, the industry maximizing wholesale price, w^*, satisfies, at $p = p^*$, the following condition.

$$(p - w)\frac{\partial}{\partial p_1}q^{11}(p, p) + q^{11}(p, p) + (p - w)\frac{\partial}{\partial p_2}q^{12}(p, p) = 0 \tag{10}$$

While it is feasible to use MFN to leverage monopoly power perfectly from the monopolist's market it is never *optimal* to do so. The optimal variable price, when the MFN is profitably adopted, will raise the common price across the products above the non-MFN price of the competitive good (which is zero), but never as high as the full industry monopoly price.Lowering the variable price to either retailer lowers the share of industry profit that the monopolist must leave with the other retailer to induce acceptance. The other retailer must be compensated with the profit from deviating *unilaterally* from contract acceptance if {accept, accept} is to be an equilibrium. And the profit from deviating unilaterally is higher the greater is w, since then the deviating retailer is competing in the market for the competitive good against a rival retailer bound by the agreement to price the competitive good as high it prices the monopoly good – and the non-deviating retailer's reaction curve in setting this price will be higher the greater is w. Lowering w for either retailer relaxes the individual rationality constraint for the other retailer.

In standard vertical control problems where the opportunity cost of a downstream retailer is exogenous, the optimal contract under ideal conditions will maximize aggregate profits and divide profits among the supply chain participants – the contract will "fully coordinate supply chain incentives" in the language of the supply chain literature. Here, the MFN contract here fails to fully coordinate the supply chain (which would require fully horizontal leverage of monopoly power) because of the endogeneity of the amount that each retailer must be compensated to meet the participation constraint.

The optimal price is less than p^*. A marginal reduction in w starting at w^* has two effects: (1) a reduction in aggregate profits; and (2) an increase in the monopolist's share of aggregate profits, which follows from the reduction in each retailer's share of profits. By the envelope theorem, the first effect is only of second order. It therefore pays the monopolist, *if* it is going to adopt MFN, to set w less than w^*, with the implication that the retail price will be less than p^*. It also follows from this that the price of the monopoly good will fall with

MFN, since the no-MFN price to the monopoly good (given the demands are independent and identical) is p^*.

Proposition 11 *Any optimal use of the MFN restraint in the monopoly - competitive fringe model in which demand is identical for the two products, and independent, will increase the price for the competitive good, reduce the price of the monopolized good, to a price that is less than the price that would be charged by a hypothetical industry monopolist.*

Proof (outline):

1. a manufacturer imposing an MFN captures the entire industry profits minus 2 x the amount that must be left with each retailer to satisfy the retailer's individual rationality constraint.

2. the retailer's IR constraint states that the retailer must earn as much under the MFN as if the retailer deviated unilaterally from the MFN equilibrium by rejecting the monopolist's offer, deciding to sell the competiitve good alone.

3. in the retail pricing subgame, in which only one retailer has deviated from {accept, accept} in the previous stage, the deviating firm's profits are higher, the greater the wholesale price faced by its competitor. The deviating firm sells only the competitive product, which it acquires at zero cost; the rival prices both goods at the same price and sources the wholesale good at price w. (This step must allow for the fact that if the two retailers are close competitors, i.e. the cross-elasticity is high, then only a mixed strategy exists.)

4. The monopolist, considering lowering its price w marginally below w^*, the wholesale price that would elicit p^*, the industry profit-maximizing priice, faces two effects : (a) a decrease in the total industry price; and (b) an increase in the share tha tmust be left with reach retailer. By the envelope theorem, the first of these effects is only of second order.

This shows that the monopolist gains by reducing its wholesale price marginally below w^* with the result that the retail price is below p^*.

This proposition is closely related to a result by Inderst and Shaffer (2016). These authors show that a monopolist facing retailers who have the option to drop the manufacturer's product in favor of a substitute product will not achieve first-best maximum profits, i.e. full channel coordination. The Inderst-Shaffer theory relies on substitution between the products; in our theory, prices are linked through the vertical restraint. Substitutability of the two products simply reinforces the effect.

2.3.3 Example

We have characterized the optimal MFN *if* the vertical MFN restraint were adopted, when retailers have the option not to carry the manufacturer's product. If MFN could be used to extract full industry profits then the profitability of the MFN restraint would be obvious. But it cannot. This raises the question of whether the monopolist would adopt the MFN. Is the amount of profits that must be left with retailers so large that the remaining profits for the monopolist are less than the monopoly profits without the MFN? We know that in the limiting case of perfect competition downstream, the MFN is not profitable. With numerical simulation of the duopoly retailer model (with monopoly and competitive fringe upstream) we find that the restraint is profitable for some but not all parameter values.

In the simulated model, distinct groups of consumers demand each product. Downstream the retail market is a Hotelling line. The consumers are located along a unit line segment, with the retailers selling from each end of the line. At each point along the line, the demand curves for the two products are

$$q_1 = 1 - p_1 \tag{11}$$

$$q_2 = a - p_2 \tag{12}$$

This is a completely general parameterization of independent linear demands, given the freedom to choose units of quanities and currency. Consumers pay a travel cost t to travel to either retailer; the price that enters the demand curve includes the travel cost. Consumers purchase from the retailer whose price inclusive of travel costs is lower, or do not purchase at all.

In this example, the exogenous parameters are a pair (a, t). Figure 3 traces out in (a, t) space the set of parameters for which the MFN is profitable.

The upshot from the example is that the power of retailers' option to drop the monopolist's product deters the monopolist from imposing the MFN restraint for some, but not all, parameters.

The bottom line from our theory of vertical MFN's, which we take forward to our application to credit cards, is simple: a vertical MFN imposed by upstream duopolists will raise the equilibrium price of a product, even beyond the fully collusive level and possibly to the detriment not only of consumers but of the firms themselves. A vertical MFN also allows a monopolist, facing a competitive fringe, to extract surplus from consumers of the competitive product by leveraging its monopoly power from its own market to both markets. When we incorporate the right of the retailers to drop the monopolist's product, and allow retailers to have market power, leveraging of monopoly power from one market to both may still be profitable but is not always so. The leveraging of monopoly power always harms consumers of the competitive good and may or may not harm consumers of the monopoly good.

3 Credit Card Networks

We now explain how the theory of vertical MFN's can be applied to no-surcharge rules in the market for credit card services.[19] The services embodied in a particular credit card are offered jointly by a credit card company and the credit card issuing bank. The price paid by a merchant, through the intermediating merchant bank, consists of the payment to these joint suppliers..[20] Preventing the merchant from surcharging is exactly the vertical MFN restraint that the merchant not charge more for the transactional services of one credit card compared to what it charges for those services of another card or for the alternatives of cash or debit.

The logic of the vertical MFN models of the prior sections applies directly. The duopoly model tells us that competition between Visa and MasterCard in setting the price to merchants is eliminated (and worse) by the no-surcharge rule, leading to higher fees. The monopoly - competitive fringe model tells us that cash customers are harmed and their purchases taxed under a no-surcharge rule, providing revenue to credit card firms imposing the rule and possibly benefitting credit card customers.

Our vertical theory, however, has ignored "sales effort" by upstream suppliers of the

[19] We explore the credit card industry in more detail in our forthcoming paper. See also our paper in *Competition Policy International* (2015).

[20] The merchant's bank (the "acquirer" plays a minor role as an intermediary, collecting a very small percentage of the merchant fee, compared to the percentage collected by the issuer.

product or service, including promotion of the product and consumer benefits (e.g., rebates or reward points) to enhance the value of the product. Sales effort is particularly important to understand for credit cards because the bulk of the fee paid by merchants for the credit card service goes to the issuing bank, via the interchange fee, at least in part to induce sales effort; and because this role of the interchange fee has been emphasized in the literature on credit cards. The issuing bank and cardholders represent one side of two-sided credit card network; the merchants and their banks represent the other side. The credit card literature establishes, convincingly in our view, that the two-sided nature of credit card networks in which each side (cardholders or merchants) benefits from the presence of the other side must be understood before drawing conclusions about the impact of practices affecting credit card fees.

The two-sided analysis of credit card networks hinges on the role the interchange fee, which is the payment from the merchant (via its bank) to the issuing bank. The interchange fee in this theory balances prices on the two sides of the market. A profit-maximizing credit card company always choses an optimal interchange fee to maximize the volume of transactions, other fees held constant. The optimal interchange fee appears inherently pro-competitive in this narrow sense.

We explain in this section that the importance of two-sidedness for antitrust analysis has been overemphasized, at least when it comes to an assessment of no-surcharge rules. An antitrust evaluation of the vertical restraint can be undertaken with the traditional insights from one-sided markets, even when we recognize the balancing role of the interchange fee. The optimal balancing of the two sides of the credit card market is equivalent to the balancing of price and promotion by a seller in any market, not something special about credit cards. Defending a practice that eliminates price competition for merchants on the basis of the positive impact on the issuer side of the credit card market is equivalent to defending a practice that eliminates price competition in any market on the basis of increased sales effort.

We elaborate on these themes in this section, starting with a review of the flow of funds in a credit card network. We outline the two-sided market theory of the credit card network and then the formal equivalence between this theory and the balancing of price and promotion in any market. We discuss the policy implications of our vertical theory of the no-surcharge rule in light of this equivalence.

3.1 The Flow of Funds in a Credit Card Network

In offering an overview of the economics of credit card networks, we focus on four-party credit card networks such as owned by Visa and MasterCard.[21] Four-party credit card networks actually involve five parties: the credit cardholder; the bank that issues the credit card (the "issuer"); the merchant; the merchant's bank, which acquires the merchant's accounts receivable (the "acquirer"); and the credit card company. Consider a credit card transaction for \$100. After the purchase by the cardholder, the acquirer pays the merchant \$100 and then collects this amount from the issuer, who then collects payment of \$100 at the end of the month from the cardholder.

In addition to these cash flows are the various credit card fees. We illustrate in Table 1 typical values for the fees associated with a \$100 transaction.[22] We assume in this table that merchants are free to surcharge consumers/cardholders (and, for simplicity, that the surcharge is a full pass-through of the merchant fees). As illustrated in the figure, the acquirer pays a network fee of \$0.10 to the credit card company as well as an interchange fee of \$2.00 to the issuer. The acquirer's total cost of \$2.10 is passed on to the merchant along

[21] The analysis of the competitive effects of no-surcharge rules apply to three-party networks, such as the AmEx network, as well. Our analysis of Visa and MasterCard reflects their current structure (as for-profit corporations) not their structure before 2007, in which they operated as a joint venture of banks, a structure that raised complicated antitrust issues

[22] Our source for the interchange fee is Visa's published set of fees for April 2015: https://usa.visa.com/dam/VCOM/download/merchants/Visa-USA-Interchange-Reimbursement-Fees-2015-April-18.pdf. As of April 18, 2015, for example, the interchange fee on "Visa Signature / Visa Infinite" credit cards were 1.65% plus \$0.05. On a transaction size of 100 dollars, this equals 1.7 percent. The interchange fee on the "Visa Signature preferred" card was 2.10% plus \$0.10, which equals 2.2 percent on a transaction size of 100 dollars. We round off these interchange fees to 2 percent, and ignore the fixed component (\$0.05 or \$0.10) of the fee. In terms of network fees, Carleton and Frankel (2005) note at p.633 that the total network fees at that time were 13 cents for an average transaction size of 76 dollars. Since credit card fees are non-linear, with lower average fees for larger transaction amounts, a reasonable guess as to average total fees per 100 dollar transation was in the range of 16 basis points. We round this off, for purposes of illustration, to 20 basis points. We note that the fees vary with credit cards even from the same credit card company, the interchange fee being higher for more exclusive cards.

with a small fee \$0.05 to cover the acquirer's cost.[23] The merchant then passes on the \$2.15 cost to the consumer via some combination of a surcharge and perhaps a change in the retail price of its product.

In our example, the merchant passes on the full amount of the \$2.15 as a surcharge, although in reality the merchant may surcharge more or less than its cost depending on the relative demand elasticities of those who buy with the card and those who use other transactions methods such as cash, holding all else equal. The issuer receives the interchange fee, pays the issuer network fee, also \$0.10, uses some of the funds to cover the costs of its issuing services, uses some to cover the costs of promotion and consumer rewards, such as travel insurance, air miles or cash back, and retains the balance as profits.

3.2 The two-sided approach to credit card networks

Denote the interchange fee by a, and the network fees paid by the acquirer and issuer by f_1 and f_2, respectively. These three parameters contain only two degrees of freedom, i.e., there is one dimension of redundancy. All that matters for payoffs to any agent in the network are the prices to the two sides of the market: the price to the acquirer/merchant side of the market for each dollar of transactions is $p_1 = f_1 + a$ and the price to the issuer/card-holder side is $p_2 = f_2 - a$. The price paid by the acquirer is passed on to the merchant along with a small charge, g, for intermediation. (The market for acquirer services is generally taken to be competitive; we will simply assume that the merchant pays a fee, $m = f_1 + a + g$.)

The issuer price is negative and is to some extent used to finance promotion and card-holder benefits, including low interest rates, air miles and possibly cash-back awards. (The remainder is used to cover the issuer network fee to the credit card company and to generate issuer profits.) The two-sided market approach postulates that the demand for credit card services, as measured by the total dollar value of transactions can be written as

$$q(p_1, p_2) = q(f_1 + a, f_2 - a) \tag{13}$$

The more promotion and benefits to cardholders via a lower (more negative) issuer price, the higher the demand for credit card transactions because cardholders are attracted by sales

[23]The acquirer fee of \$0.05 is purely illustrative, rather than based on specific data sources.

promotion undertaken by the issuer. The lower the acquirer/merchant fee the higher the demand because more merchants are attracted to the card leading to greater coverage and more opportunities for the cardholders to use the card.

The credit card company typically sets the fees, f_1, f_2, and a, of the credit card network. The credit card literature posits, naturally, that the parameters of the network are chosen to maximize the profit of the credit card company:

$$\pi = (f_1 + f_2 - c)q(f_1 + a, f_2 - a) \tag{14}$$

where c is the cost to the credit card company per dollar of transaction. Because of the separability of this profit function, the profit-maximizing value of the interchange fee, a, maximizes quantity, i.e. the volume of transactions, given the network fees. The credit card company must balance prices on two sides of the market, in order to maximize quantity, which it will do whatever it its level of market power.[24] An interchange fee that is too high will discourage merchants from carrying the card. An interchange fee that is too low will not fund as many benefits to attract consumers.

Maximizing output with respect to the interchange fee, holding network fee constant, yields the following necessary condition for the optimal interchange fee. Let ε_1 and ε_2 be the elasticities of q with respect to p_1 and p_2 .

$$\frac{\varepsilon_1}{p_1} = \frac{\varepsilon_2}{p_2} \tag{15}$$

Given that the interchange fee chosen by a rational credit card company maximizes output, all else equal, it might be hard to see how an excessive interchange fee could possibly present a competition policy concern. High interchange fees are not necessarily a consequence of the exercise of market power. As the lierature makes clear, and we agree, a business practice such as the no-surcharge rule, will affect both sides of the market.

[24] This description incorporates an important assumption: that the interchange fee, a, is non-neutral. Suppose that cash-back benefits were a perfect substitute to consumers for a decrease in credit card surcharges. That is, suppose that an increase in the surcharge of 10 basis points would be offset perfectly for the consumer by a 10 basis point cash back benefit on the credit card bill. Then as numerous articles have pointed out, changes in the interchange fee would have no effect on net payoffs to parties in the network: an increase in the interchange fee would lead to equal and offsetting increases in the surcharge and cash-back benefits.

one cannot assess a business practice by its effects on only one side of the market.

Klein, Lerner, Murphy and Plache (2006) capture the literature's interpretation of the interchange fee:

"[I]nterchange fees are not a measure of payment card system market power. Interchange fees influence *relative* prices paid by cardholders and merchants, not the total price of a payment card system, that is, the sum of the prices paid by cardholders and merchants. The market power of a payment system determines the ability of the payment system to charge a total price above costs, but has no predictable effect on relative prices. The relative prices paid by cardholders and merchants are determined by two-sided market balancing considerations. Accordingly, the level of interchange fees has no particular relationship to the presence or absence of market power. In fact, the economic effect of balancing,... through interchange fees (for open-loop systems) ... is to maximize payment system output rather than to exercise market power by restricting output." Klein et al, p.575.

3.3 The two-sided market theory is equivalent to the Dorfman-Steiner theory

How can the interchange fee be the major component of a "price" in our interpretation of credit cash flows yet be regarded by Klein et al as having only the role of balancing prices to maximize volume, with no relationship whatsoever to market power? And how does the nature of the credit card market as two-sided affect the application of our theory to credit card no-surcharge rules?

The role of the interchange fee is to divert some portion of the fee charged to merchants to the issuer tasks of sales promotion which includes the possible provision of consumer benefits in the form of rewards. But a firm in vitually any market diverts some revenue from sales to promotion. The optimal expenditure on promotion as a ratio of revenue is given by the Dorfman-Steiner (1954) theorem:

$$\frac{A}{pq} = \frac{\eta_A}{\eta_p} \tag{16}$$

where the η_A and η_p are elasticities of demand with respect to advertising and price. Since the allocation of funds per unit to promotion (i.e. to issuers) is $(a - f_2) = -p_2$, we can label $A = -p_2 q$ as the total expenditure on promotion. There is no difference between the problem that a credit card company faces in diverting revenue to issuer activities of promotion via the interchange fee, and the problem that any firm faces in diverting revenue to promotion.

Let $Q(p_1, A)$ be the demand for credit card transactions as a function of p_1, the price to the acquirer/merchant side of the market, and A. That is, $Q(p_1, A)$ is defined implicitly as the solution to $Q - q(p_1, A/Q) = 0$. Let η_p and η_A be the elasticities of $Q(p_1, A)$, so-defined, with respect to p_1 and A.

Proposition 12 *The characterization of the optimal interchange fee (15) is equivalent to the Dorfman-Steiner theorem (16).*

The interchange fee is the revenue *per unit* that is diverted to promotion, but of course this is the same problem as choosing the optimal portion of total revenue to devote to promotion. The first-order conditions from the two ways of formulating the optimal promotion, or optimal interchange fee, are equivalent.The "optimal interchange fee" is a problem faced by any firm in any market, and the solution is no different for a credit card company than for any other firm. The economics of credit card interchange fee are simply the Dorfman-Steiner theory with new notation.

Nor is the quantity-maximizing property of the optimal interchange fee unique to the credit card market. Consider a firm in any market facing demand $Q(p, A)$. Define $\tilde{q}(p, a)$ to be demand as a function of price and promotional expenditure per unit. That is, define $\tilde{q}(p, a)$ implicitly as the solution to $q - Q(p, aq) = 0$. Suppose (for simplicity) that the firm's unit cost is constant. Let $x = p - a - c$. We can write the firm's profits as $\pi(p, a) = (p - a - c)\tilde{q}(p, a)$. With a simple change in variables, substituting $p = x - a - c$, we can write profits as a function $\tilde{\pi}(x, a) \equiv x\tilde{q}(x - a - c, a)$. Given the separability of $\tilde{\pi}(x, a)$, the profit-maximizing choice of a *is* the quantity-maximizing choice of a, conditional upon x. In summary,

Proposition 13 *For any firm facing demand that depends on* p *and* A, *the optimal expenditure on promotion per unit quantity,* a, *holding constant* $x \equiv p - a - c$, *maximizes output.*

The economic point is simpler than the algebra. Any firm in any market has the option of increasing price by 1 dollar and allocating the entire extra dollar per unit to promotion. Obviously, the firm will exercise this option if and only if doing so increased quantity. (The net revenue per unit is unchanged with the exercise of this option, so profits increase if and only if quantity increases.) Solving the first-order conditions for the optimal exercise of this option again yields the Dorfman-Steiner expression. The exercise is simply another way of formulating the Dorfman-Steiner tradeoff faced by any firm. The trade-off is exactly precisely the same as that undertaken by a credit card firm in selecting optimal interchange fee: raising the interchange fee by 10 basis points raises by price and a by 10 basis points. In short, the "optimal interchange problem" is a problem faced by any firm in any market where promotion occurs, not something unique to credit card systems or payment systems more generally. The quantity-maximizing property of optimal promotional expenditures per unit, all else equal (specifically, when prices is adjusted one-for-one with changes in promotional expenditures per unit) is not a property unique to credit cards.

3.4 Policy Implications of the Equivalence

How does this interpretation of credit card economics feed into our conclusion that the no-surcharge rule is anticompetitive both in suppressing competition among credit cards and competition with other transactions methods? Proponents of the two-sided market approach to credit card economics are correct in their view that the welfare effect of practices affecting the interchange fee cannot, as a matter of economic theory, be assessed by examining only one side of the market. And our theory of vertical MFNs as applied to no-surcharge rules is limited to only the merchant side of the market. Indeed, the proponents of the no-surcharge rule could claim that the promotional benefits created by the rule (which allows a higher interchange fee) justify the rule.

To defend the no-surcharge rule because the elevated interchange fee it leads to creates incentives for additional promotion would be, in our view, a bold antitrust defense. Although we leave the legality of such a defense to legal scholars, we note the following: A horizontal cartel that elevates price will virtually always generate more sales effort (non-price competition) as a result. This consequence is well known since at least Stigler (1964). The mere fact that sales effort is generated is unlikely to be a sufficient defense to exonerate conduct that suppresses price competition. As Scott Morton (2013, p.1) states, "the consensus among scholars and policy makers over many years is that any efficiency-enhancing apects of ... a naked horizontal agreement are almost always swamped by anticompetitive effects."

Indeed, we suspect that it would be unusual under the Sherman Act to use a rule of reason to justify a cartel that raises price by the claim that it generates so much promotion that it is efficient to allow the cartel to operate. Here, in the credit card case, the conduct that could be described as suppressing competition is not a cartel but rather the no-surcharge rule, a rule that harms both cash customers and perhaps some credit card customers. Cash customers are harmed as we have already described in the monopoly competitive fringe model. Credit card customers may be harmed because they pay too high a price as in the duopoly model. Entrants, parties that we have not discussed to this point, are harmed because they are unable to enter and attract customers by charging a low price.[25]

To claim that the NSR is justified because of the sales effort generated is an argument that at the very least should require an empirical demonstration. Vertical restrictions such as exclusive dealing can be defended under a rule of reason if, in the presence of market power, the restrictions generate net pro-competitive effects as a result of the increased promotion rather than anticompetitive effects as a result of the suppression of competition across suppliers. At the very least, the same showing should be required here, where the suppression of competition is in fact a horizontaleffect across suppliers (credit card networks).

The theory of the interchange fee as balancing the two sides of credit card networks is identical, except for relabeling, to the theory of balancing higher prices with greater promotion or quality expenditure. Nothing in the relabeling justifies a special treatment for credit card markets in allowing rules that suppress price competition.

In our analysis of the impact of no-surcharge rules, we have left open the possibility that the rule could increase total surplus. And it is easy to see that the no-surcharge rule could have a positive impact on total surplus. Consider, for example, the case of a monopoly credit card firm facing competition from cash. Assuming that the cost of transacting is the same between the two methods, monopoly pricing in the absence of the no-surcharge rule causes a deadweight loss. A no-surcharge rule forces the retailers to charge identical retail prices whether a customer uses cash or credit to complete the transaction and thereby eliminates one source of inefficiency from the monopoly distortion: equal costs means that equal prices are required for first-best efficiency.

[25] For example, Discover has had difficulty entering and expanding in the credit card market.

The price elevation from the implicit tax on cash purchasers creates deadweight loss that could be offset by the increase in transaction efficiency.[26] Even in this case, we question the desirability of a competion policy that allows a monopolist to defend conduct that harms cash customers and entrants on the grounds that it corrects a distortion created by the existing market power of the credit card firm. There are many examples of practices by which a dominant firm can increase the price (or decrease the quantity) of competitive rivals and thereby increase total surplus.[27] In none of these cases, as a matter of policy, does an increase in total surplus successfully defend the practice.

4 Conclusion

This paper has developed a general theory of vertical MFNs, in which a supplier uses contracts to control the retail price of its product in relation to the price of its rivals. We use several different models to lay bare some of the essential forces that influence pricing in such an environment. When suppliers compete as duopolists, the vertical MFN turns the rivals' substitute products into complements with the result that the wholesale and retail price of each product rises. A vertical MFN reduces or eliminates the incentive to undercut a rival's wholesale price and moreover, through the cost externalization effect ,encourages rivals to keep raising their prices even beyond the point of joint profit maximization. Indeed, a prisoners' dilemna can arise in which suppliers are worse off as a result of the MFN but the MFN remains the dominant strategy choice. In a setting in which there is a competitive fringe, a different insight emerges. A monopoly supplier is able to use an MFN effectively to tax the purchases of the competitive product and capture the tax revenue as profit. In some cases, the purchasers of the monopoly good benefit; in other circumstances these purchasers are harmed. We apply our general results to the credit card market. Direct application of our theory to the credit card market suggests that the use of a vertical MFN, namely the no-surcharge rule, harms cash purchasers by raising their price, harms entrants by preventing them from entering therough a strategy of charging a low price, and perhaps also harms

[26](See Rochet and Tirole(2002)).

[27] An example is a exclusivity restriciton on buyers that raises the monopolist's market share at the expense of competiive, lower-markup rivals.

credit card purchasers. The defense that the no-surcharge rule assists in creating incentives to promote its product by raising the interchange fee is no different than the principle established in the economics of one-sided markets that conduct that suppresses competition can be pro competitive if sales effort stimulates demand. We show that the proposition that interchange fees , all else equal, are chosen to maximize volume is not a special argument reserved for two sided markets or credit cards. It is in fact a general result that applies to all one sided markets where promotion is involved. We conclude that analsyis of the impact of the no-surcharge rule in credit card markets deserves no special treatment compared to the use of other mechanisms in one-sided markets that can also be claimed to increase sales effort. We conclude that the no surcharge rule is likely to harm competition and are skeptical that one could show under a rule of reason analysis that the no surcharge rule is procompetitive on balance because it enables elevation of the interchange fee that induces additional promotion that stimulate sales.

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APPENDIX A: PROOFS OF PROPOSITIONS

This appendix contains the proofs not included in the text.

Proposition 4 *With linear demand and $c = 0$, adoption of the MFN restraint is a dominant strategy by both firms in the first stage of the game. For $d \in (0, \frac{1}{2})$, the firms are worse off with the joint adoption of the restraint.*

Proof: Suppose that costs are 0, and that the goods are differentiated, with a symmetric linear demand system

$$\begin{aligned} q_1(p_1, p_2) &= 1 - p_1 + dp_2 \\ q_2(p_1, p_2) &= 1 - p_2 + dp_1 \end{aligned}$$

$\{0, 0\}$ **Pricing subgame**: In the pricing game following $\{0, 0\}$, the first order conditions for the two firms can be solved to give the standard linear Bertrand reaction curves:

$$R_1^{00}(w_2) = \frac{1}{2} + \frac{d}{2}w_2 \tag{17}$$

$$pR_2^{00}(w_1) = \frac{1}{2} + \frac{d}{2}w_1 \tag{18}$$

Solving the equilibrium yields $w_{00}^* = 1/2 - d$, with a net profit for each firm

$$\pi_{00}^* = 1/(2 - d)^2 \tag{19}$$

$\{1, 1\}$ **Pricing subgame:** Following $\{1, 1\}$ decisions on the MFN, the retail price is $p = (w_1 + w_2)/2$. The profit function is

$$\pi_1(w_1, w_2) = q_1(p, p)w_1 = [1 - (1 - d)\frac{(w_1 + w_2)}{2}](w_1 - c) \tag{20}$$

Solving the first-order conditions for the reaction functions yields

$$R_1^{11}(w_2) = \frac{1}{(1 - d)} - \frac{w_2}{2} \tag{21}$$

$$R_2^{11}(w_1) = \frac{1}{(1 - d)} - \frac{w_1}{2} \tag{22}$$

These reaction functions reveal the strategic complementarity of the pricing decisions. Solving these reaction functions with $w_1 = w_2$ yields

$$p_{11}^* = w_{11}^* = \frac{2}{3(1-d)} \tag{23}$$

This is also the retail price. Note that for $d = 0$ (the firms are not competing), then $w_{11}^* = 2/3 > 1/2$, which is the joint monopoly price. Even when the firms do not compete, the agreements raise price above the joint monopoly level, as the analytical theory predicts. And note that price is increasing in d . Solving for profit yields

$$\pi_{11}^* = \frac{2}{9(1-d)} \tag{24}$$

The impact on profits is negative if

$$\pi_{11}^* < \pi_{00}^* \iff \frac{2}{9(1-d)} < \frac{1}{(2-d)^2} \iff d(2d+1) < 1 \tag{25}$$

Proposition 12: The characterization of the optimal interchange fee (15) is equivalent to the Dorfman-Steiner theorem (16).

Proof:

Since $A = p_2 q$, the LHS of (16) equals p_2/p_1 . Since (15) is equivalent to p_2/p_1, to prove the proposition we must show that

$$\frac{\eta_A}{\eta_p} = \frac{\varepsilon_2}{\varepsilon_1} \tag{26}$$

or

$$\frac{\partial Q/\partial A}{\partial Q/\partial p_1} \cdot \frac{A}{p_1} = \frac{\partial q/\partial p_2}{\partial q/\partial p_1} \cdot \frac{p_2}{p_1} \tag{27}$$

Since $A = -p_2 q$, this in turn is equivalent to showing

$$\frac{\partial Q/\partial A}{\partial Q/\partial p_1} = \frac{\partial q/\partial p_2}{\partial q\ /\partial p_1} \cdot \frac{1}{q} \tag{28}$$

In short, to prove the proposition we must show (28). Let $F(p_1, q, A) = Q - q(p_1, \frac{A}{Q})$. From the definition of $Q(p_1, A)$ as the solution in Q to $F(p_1, Q, A) = 0$, and the implicit function theorem, it follows that

$$\frac{\partial Q(p_1, A)/\partial A}{\partial Q(p_1, A)/\partial p_1} = \frac{-[\partial F/\partial A]/[\partial F/\partial Q]}{-[\partial F/\partial p_1]/[\partial F/\partial Q]} = \frac{\partial F/\partial A}{\partial F/\partial p_1} = \frac{\partial q/\partial p_2 \cdot (1/q)}{\partial q\ /\partial p_1} \tag{29}$$

which is identical to (28).

Figure 1: Reaction Curves for 00 and 11 Pricing Subgames

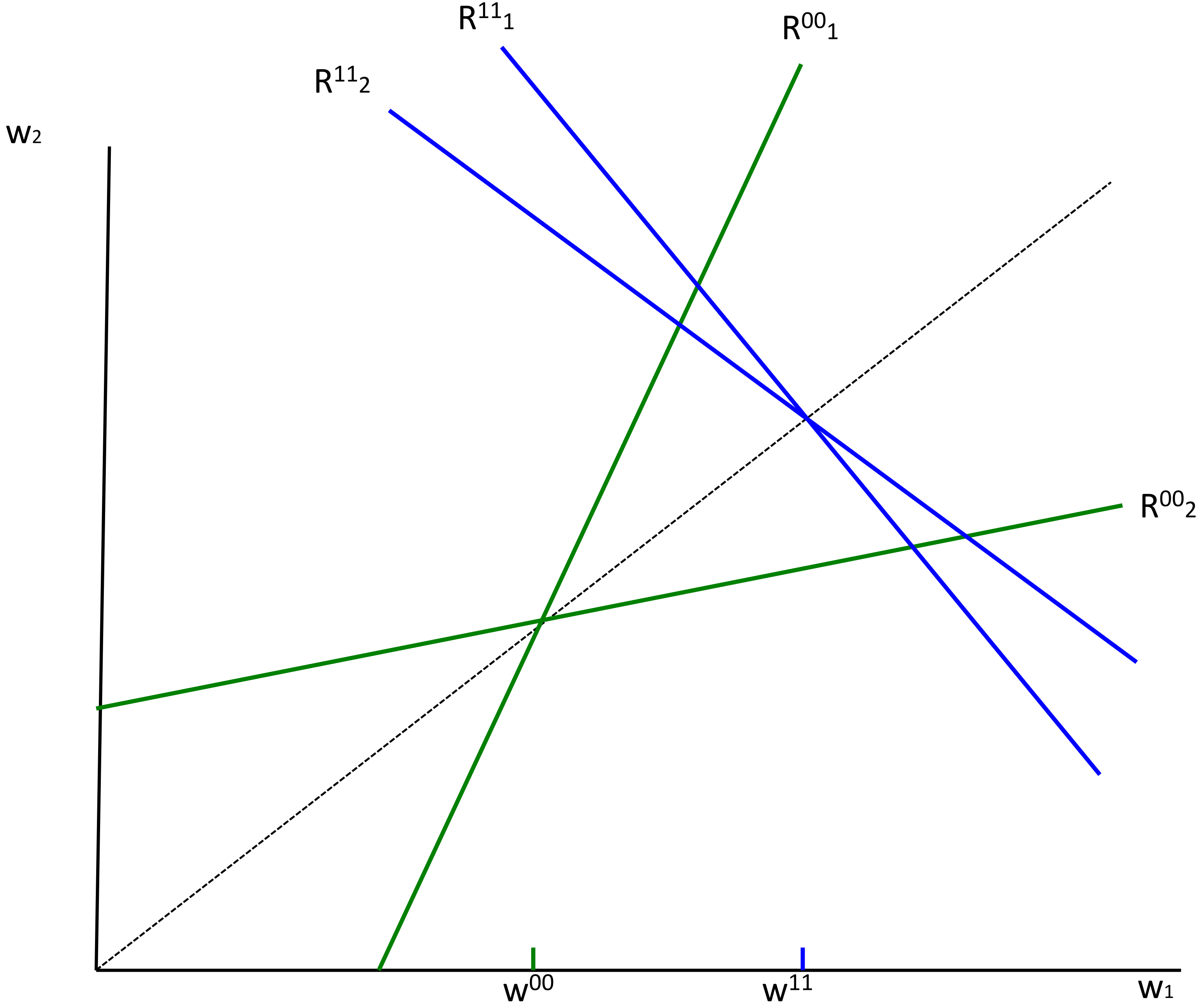
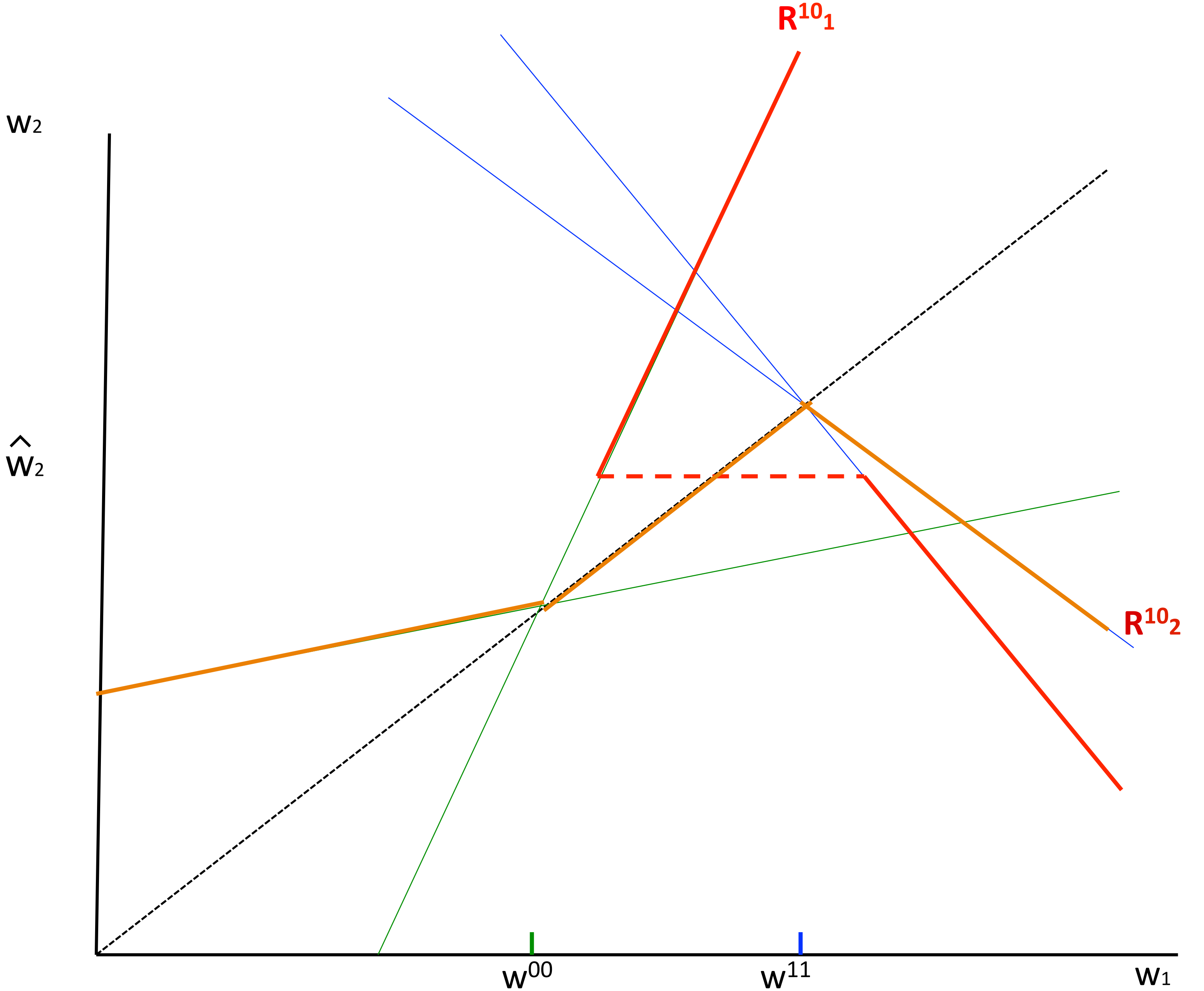


Figure 2: Reaction Curves for {1,0} Pricing Subgame

FOR THE DERIVATION OF THE LINEAR DEMAND CASE IN THE APPENDIX



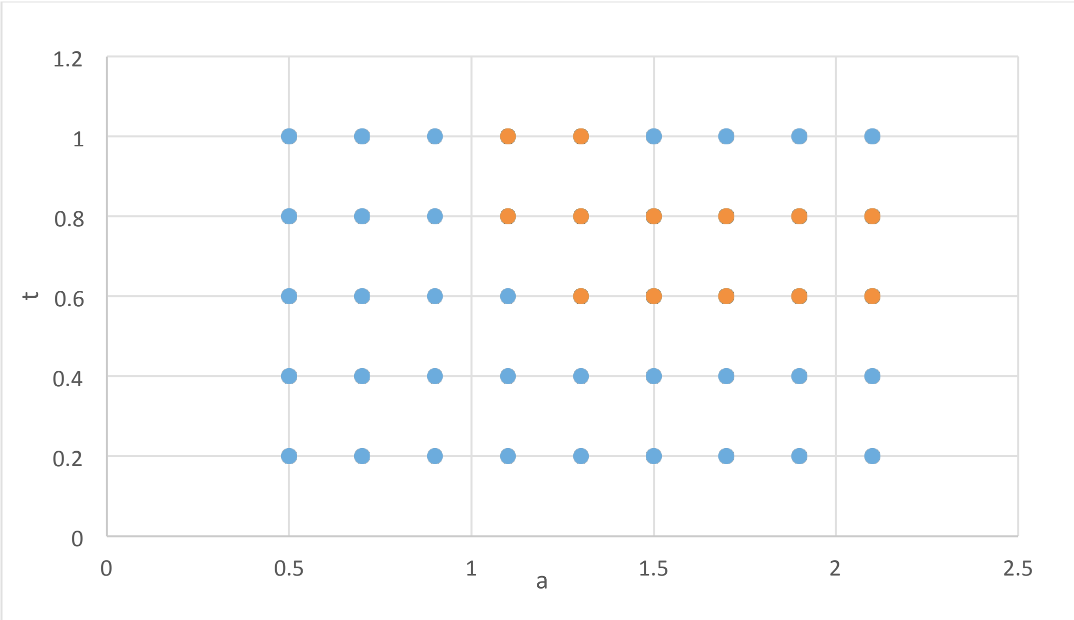


Figure 3: **Linear Demand Example for Monopoly – Competitive Fringe in which retailers have the option to drop the monopolist's product:**

Values of exogenous parameters (a,t) for which an MT is not profitable (blue) and is profitable (orange)

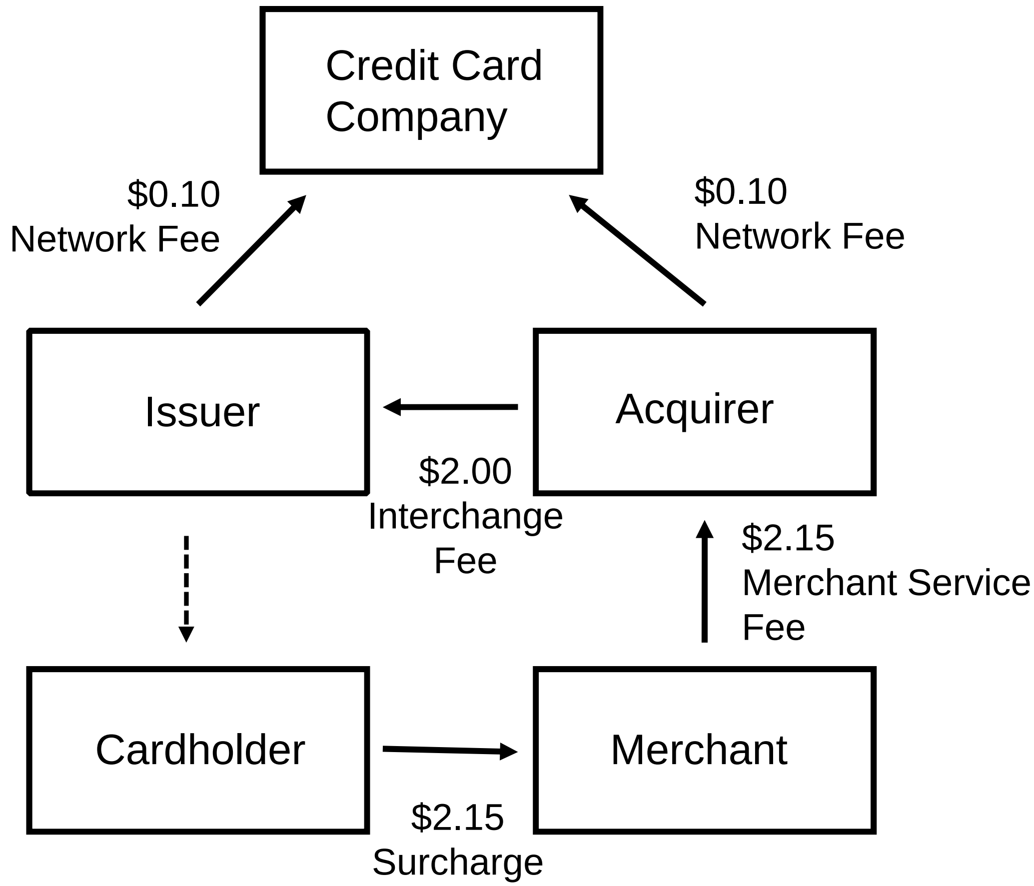


Table 1:
The Flow of Funds in a Credit Card Transaction with a Surcharge Fee