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

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Abstract

A vertical MFN prohibits a multiproduct retailer charging more for a supplier's product than for the products of rival suppliers. In the market for credit card services, this restraint takes the form of a no-surcharge rule: that a retailer not surcharge for transactions with a particular credit card. This paper sets out a general theory of the vertical MFN restraint and then applies the theory to credit cards. In a symmetric, differentiated duopoly, the vertical MFN raises price from the Bertrand equilibrium value to a level greater than the fully collusive value. In a monopoly–competitive fringe model, the restraint can allow the dominant firm to leverage its power to extract surplus from the entire set of consumers. The theory applies directly to the credit card market. Contrary to accepted wisdom and an important legal case, the two-sided nature of the credit card market does not mandate new economic foundations for competition policy.

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1 Introduction

This paper presents a theory of vertical most favored nation clauses and then applies the theory to the credit card industry. A vertical MFN is a restraint that prevents a retailer from charging more for a 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* in credit card contracts with retailers: the retailers cannot charge more for purchases made with the credit card than for purchases made with other credit cards, cash or debit.

While vertical MFNs have been used in a number of markets, such as the markets for airline travel packages and cigarettes, the most important has been in the market for credit card services. Credit cards were used for 10.8 trillion dollars of transactions in 2015,[2] more than 10 percent of world GDP. The range of public policies on the no-surcharge restraint is enormous. In the European Union, surcharges are allowed but have been limited since March 2015.[3] Canadian competition authorities challenged no-surcharge rules, unsuccessfully, in 2010.[4] 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, but allowed no-surcharge rules.[5][6] In other words, the agreement ruled out vertical restraints against steering via persuasion or promotions but allowed vertical restraints against merchants' use of the price mechanism, the most direct method of steering, or 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*

[1] The vertical MFN differs from a conventional MFN in that it is a contract between the supplier and a retailer that places a restriction on the parameters of a contract between the retailer and a *third* party, the retailer's purchaser. A conventional MFN places restrictions on the terms of future transactions between the contracting parties alone. (For example, a buyer may be guaranteed the supplier's best price.) A vertical MFN is sometimes known as a "price parity" restraint.

[2] HSN (2016): 9.

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

[4] *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.

[5] Subsequently, the Department of Justice prevailed in a case against American Express that extended the conditions of the agreement with Visa and MasterCard to American Express as well. This decision was reversed on appeal to the Second Circuit Court. We analyze the case below.

[6] "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.

no-surcharging restraints.

We develop the general theory of the vertical MFN in a setting in which upstream suppliers sell through a set of common retailers. This describes the conditions of sale for many products and in particular is a reasonable description of the competitive setting between Visa and MasterCard, the two largest credit card service suppliers worldwide. We initially impose a "must-carry" restriction on retailers. This allows us to focus on the impact of the restraint on the main source of competition in the market: consumers' ability to substitute away from a product at the point of sale as its retail price is increased. In a duopoly setting, when both firms adopt the vertical restraint, then (assuming symmetry) retailers charge a common retail price for both products that equals the average wholesale price. The impact of the restraint is to raise the wholesale price from the Bertrand equilibrium price to a price even greater than the joint profit-maximizing wholesale price that would be achieved with perfect collusion. This is a consequence of two effects on the supplier's incentives. Under joint adoption of the restraint, when a supplier raises its wholesale price by a dollar, its rival's retail price goes up by 50 cents. Demand is diverted to the firm from its rival through this *diversion effect*. The second effect is an externality unique to our setting. When the supplier raises its wholesale price by a dollar, its own retail customers bear only half the cost of the price increase, as its retail price rises by only 50 cents. This *cost externalization effect* raises the wholesale price as a result of joint adoption of the vertical restraint even where the products are independent in demand. The firms, not just consumers, may be worse off as a result of the adoption of the vertical MFN. Under a linear demand parameterization, however, adoption by each firm is a dominant strategy. Anticipating our application to credit cards,where a dominant credit card faces competition from consumers' ability to transact with cash or debit cards, we develop the model under an alternative market structure. An upstream monopolist faces a competitive fringe producing a differentiated product. All suppliers again sell through a common set of retailers. Can the monopolist, by adopting the vertical MFN, leverage monopoly power over its own good to capture surplus from consumers of both goods? The answer is yes, but the monopolist's leveraging ability is limited to capturing less than the full profits of an industry monopolist.

The market in our application is for credit card services, which consist of the right of consumers and retailers to transact with the card and receive other benefits as well (e.g., cardholder rewards). The service is offered jointly by the credit card company and the bank issuing the card through the multiproduct retailers. The fact that credit cards are offered by upstream suppliers through multiproduct retailers to final consumers allows direct application of our vertical theory. In a market where merchants could surcharge, competition between Visa and MasterCard on lower charges to merchants would be intense because these charges would be passed through as surcharges and consumers could easily adopt the lower cost card at the point of sale. No-surcharge rules suppress this dimension of competition entirely. And no-surcharge rules force retailers to spread the costs of credit cards, typically in the range of 2 percent of prices, across all transactions including cash. This allows a dominant credit card service supplier to externalize the cost of its card, leveraging to some extent its market power over cash and debit customers.

A credit card network is a canonical two-sided market in that both cardholders and merchants must be attracted to the network for it to succeed.[7] Our analysis shows that despite its two-sided property, one can analyze a credit card market using the vertical structure of a one-sided market in which retailers pay wholesale prices for credit card services and in which the rewards and other benefits to consumers are treated as promotion or quality. In a conventional antitrust case involving a vertical restriction (e.g., resale price maintenance), the antitrust rule is the following: the Plaintiff must show that the conduct at issue restricts competition (e.g., raises prices); then the Defendant must show evidence of the pro-competitive feature of the vertical restraint (e.g., that it encourages promotion); and finally the court weighs the two effects. Our analysis shows that the two-sided nature of the credit card market should not alter the antitrust treatment of the no-surcharge restraint in credit card networks.

Antitrust analysis in a two-sided market such as credit cards is not just an academic issue. In the recent *American Express* case, the appellate court rejected the district court's decision that American Express's no-steering restraints harmed competition.[8] The district court had based its decision on the fact that after the plaintiff (the U.S. government) had shown an anticompetitive effect at the retail level, American Express had failed to meet its burden to provide a pro-competitive justification that the court could then balance against the competitive harm. The appellate court ruled that the district court had erred in requiring the government to initially show that only retailers were harmed by the no-steering rule. A proper antitrust analysis, according to the appellate court, must "consider the two-sided *net* price accounting for the effects of the [restraints] on both merchants and cardholders." [emphasis added].[9] Given the appellate court ruling, there is now a different antitrust standard for examining vertical restraints in one-sided versus two-sided markets. We show that no economic justification exists for this difference in antitrust rules.

[7] A more precise definition, which we discuss below, is from Rochet and Tirole (2006) at p.664: "[A] market is two-sided if the platform can affect the volume of transactions by charging more to one side of the market and reducing the price paid by the other side by an equal amount; in other words, the price structure matters, and platforms must design it so as to bring both sides on board."

[8] United States v. American Express Co., No. 15-1672 (2d Cir. 2016) ("*Amex* II"), overturning U.S. v. Am.Express Co. 88 F.supp.3d 143(E.D.N.Y.) ("*Amex* I").

[9] *U.S. v. Am. Express Co.*, 2016 WL 5349734 (2d Cir. Sep. 26, 2016) at 54

Ours is the simplest possible model that captures the anticompetitive impact of no-surcharge rules. The papers in the sizable literature on credit card economics 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.[10] Our vertical MFN model is more focused, incorporating for the most part market power only for providers of this service. Boik and Corts (2014) ("BC") investigate the effects of price parity rules imposed by duopolist platforms on which buyers and sellers can transact. Credit cards could be interpreted as platforms for transactions in the BC duopoly model, whereas in our model credit cards are a service offered through the competitive retailers. However, BC incorporate market power not only for upstream suppliers but for a monopoly retailer as well, thereby commingling the effects of market power of retailers with market power of firms imposing the vertical restraint. Moreover, our model incorporates a monopoly-competitive fringe case that is essential for application to credit cards; BC do not claim applicability of their model to the no-surcharge rule in credit card markets.[11] Edelman and Wright (1015) also consider the impact of a restriction that retailer prices be the same for all upstream goods, but in a more complex model with a specific monopolistically competitive structure for the retail sector that once again incorporates the assumption that retailers have price-setting power. Our simpler model allows a clear characterization of the effects of the vertical restraint at issue. It also allows us to establish logical parallels between the two-sided approach to credit card markets and price theory in a conventional one-sided market. The appelate court in *Amex* failed to recognize this parallel, arguing erroneously that because they are two-sided, markets for credit card services require a departure from established principles of competition policy.

2 Duopoly

We analyze a vertical MFN (also referred to as a "vMFN" or simply MFN) in both a duopoly setting and a monopoly-competitive fringe setting. To motivate our model, we note that in

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

[11] Liu, Sibley and Zhao (2017) (LSZ), in a paper written simultaneously to this one, investigate vertical MFN's. LSZ analyze vMFN's in a linear demand model, as do Boik and Corts, but consider the case of asymmetric duopolists as well and extend the model to consider a restraint requiring the merchant to offer a margin no higher on the supplier's product than for a specified competing product.

our application to credit cards, when surcharges are adopted a credit card company faces five sources of competitive discipline against increasing fees to merchants. 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;

- 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 sources of competition the first is surely the strongest in practice since when a higher merchant fee is passed on to consumers via a higher surcharge, a consumer can simply switch credit cards to purchase the identical good at a lower price. In developing the general model of vertical MFNs we therefore focus initially on the impact of the MFN on the first source of competition, that arising from the ability of consumers to switch products. We 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 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 $q_2(p_1, p_2)$ where p_i is the price of product i. These demand curves are assumed to satisfy standard conditions for uniqueness of equilibrium in Bertrand competition and for concavity of profit functions.These standard conditions include the inequality $\partial q_1/\partial p_2 < -\partial q_1/\partial p_1$. For simplicity, the demand functions are also assumed to be symmetric.

We consider the following game. The two upstream suppliers decide simultaneously whether to adopt a vMFN. 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. (As discussed above, we initially set aside the option of retailers to drop a product, adopting instead a "must-carry" assumption.) Finally, the retail market clears.

2.2 Equilibrium

Consider first the retail market equilibrium conditional upon the choices of vMFN (or not) by the upstream suppliers and wholesale prices (w_1, w_2). If neither supplier imposes a vMFN, then competitive retailers simply pass on wholesale prices as retail prices, $(p_1, p_2) = (w_1, w_2)$. If the vMFN restraint is imposed by *both* suppliers, then – given the symmetry in demand - the retail prices equal $(w_1 + w_2)/2$, since this is the uniform price that yields zero profits. Suppose that only one supplier sets a vMFN. Then given the pair of wholesale prices (w_1, w_2) if the supplier imposing the vMFN 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 vMFN 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 a vMFN, the retail price is $p = (w_1 + w_2)/2$.

We move next to the wholesale pricing game, conditional upon the supplier choices on MFNs. 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 vMFN restraint. We start by comparing the $(0, 0)$ pricing subgame with the $(1, 1)$ subgame, then move on to solving the entire game.

2.2.1 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:

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

2.2.2 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) :

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

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

We assess the competitive impact of the vMFN, 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 $\pi_1^{11}(w_1,w_2)$, 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.[12]In addition to this local 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 vMFN agreements. The *cost-externalization effect* is the benefit from raising the wholesale price that accrues to a supplier from the fact that retailers pass on only half of any upstream price increase to retail consumers of the upstream firm's product. Half the cost is externalized

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

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 wholesale price automatically raises the retail 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 its wholesale price. Hence, both wholesale prices increase as a result of the vertical restraint.

We can compare the incentive to raise the prices following the joint adoption of the vMFN restraint with the incentive that arises joint profit maximization (i.e., full collusion).[13] 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-vMFN 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 $\frac{\partial q_2}{\partial p_1} < -\frac{\partial q_1}{\partial p_1}$ yields a sharp result. In terms of the incentive to raise price, the vMFN is even more anti-competitive than full collusion:

Proposition 1 *If both suppliers have adopted a vMFN, 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 vMFN. Since these firms would set price to maximize collective profit in the absence of any vMFN agreements, this means that the situation of both firms signing the vMFN 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

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

[13]By "full collusion", we mean joint profit maximization.

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

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

The move to a higher price than the fully collusive price under the vMFN can be understood in terms of a switch from substitute products to complements. Under the vMFN 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. The vMFN, in other words, introduces into the market Cournot's "problem of complements" (Cournot 1838).

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 their relationship as strategic complements in the $(0, 0)$ game.[14]

Under the vMFN, the reaction curves are thus 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 even further through an increase in its own wholesale price. Figure 1 compares the subgame pricing equilibria of the $(0, 0)$ Bertrand game and the $(1, 1)$ vMFN game for the case of linear demand.

[14] Taking the case of linear demand, $q_1(p_1, p_2) = 1 - p_1 + dp_2$, the profit function for firm 1 in the $(1, 1)$ game 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. The move from strategic complementarity to strategic substitutes with the vertical restraint is parallel to the same effect in the duopoly platform competition model of Boik and Corts (2016).

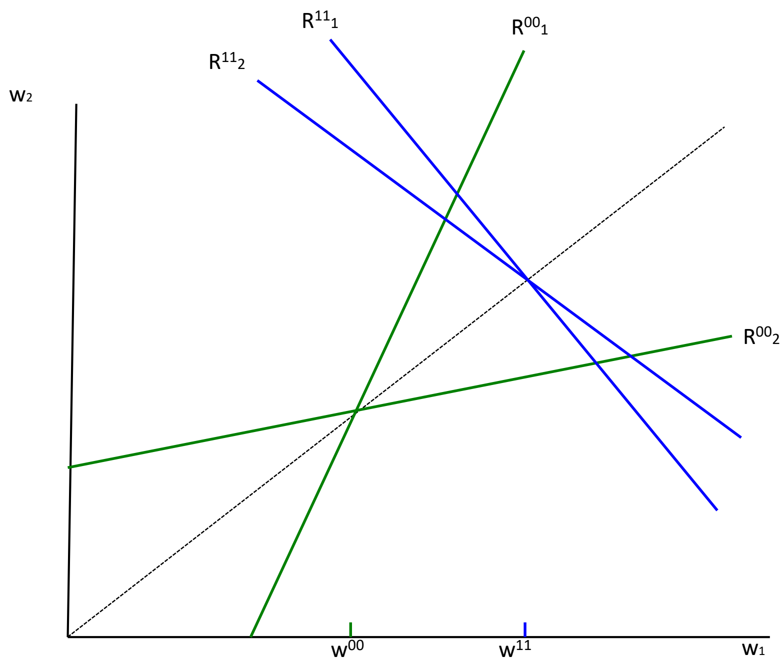

Figure 1: Reaction Curves for 00 and 11 Duopoly Pricing Subgames

It follows immediately from Proposition 2 that the adoption of the vMFN 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 the assumption of symmetry, the vMFN restraint is not binding on any retailer in equilibrium.*

In assessing the empirical importance of a vertical restraint, it is tempting to think of the extent to which the restraint 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 vMFN restraint is not binding at all on equilibrium retailer pricing 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 vMFN restraint is not important, in deciding whether the restraint is anticompetitive.

For policy analysis of the vMFN restraint in a duopoly market in which both firms are observed to have adopted vMFN's, the comparison of the $(1, 1)$ and the $(0, 0)$ subgames is enough to conclude that the vMFN harms consumers. The move from the $(1,1)$ equilibrium to the $(0,0)$ equilibrium could be induced by a prohibition of the vMFN. Any other subgame, and the complete game, are strictly speaking irrelevant. 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.

2.2.4 The $(1,0)$ Pricing Subgame

Recall that the vMFN constraint is binding only when imposed by the higher-priced firm. When firm 1 alone has adopted the vMFN restraint, its reaction curve is discontinuous: at low values of w_2 firm 1's best response is $w_1 > w_2$, which puts it on the vMFN 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, $d \in (0,1)$:[15]

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

The mixed-strategy equilibrium of the $(1,0)$ pricing subgame is the simplest possible kind of mixed strategy equilibrium. 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.

2.2.5 The Entire Game

We know that when the cross-elasticity of demand is small the suppliers are worse off by jointly adopting the vMFN 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

[15] 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 .

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. For* $d \in (0, 0.5)$*, the firms are worse off with the joint adoption of the restraint.*

The prospect of extracting a transfer from the rival through the cost-externalization effect drives the incentive of an upstream firm to adopt the vMFN 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 vMFN adoption. Adopting the vMFN is a dominant strategy. Yet firms are worse off when the cross-elasticity of demand is low: the firms are in a Prisoners' 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 vMFN because the advantages of avoiding intense Bertrand competition more than offset the costs of excessive pricing.[16]

3 Monopoly Supplier and Competitive Fringe

We consider next the impact of a vMFN imposed by a monopolist supplier facing a competitive fringe producing a substitute good.[17] This market structure is essential for the application of the theory to the no-surcharge restraint on credit cards in markets in which some purchases are from cash (or debit) customers. Cash purchases are analogous to a competitive fringe alternative to credit card services.

Looking ahead to our application to credit cards, we seek answers to two questions in this model. First, we would like to understand the impact of the no-surcharge restraint on cash customers. Cash purchasers are analogous to the purchasers of the competitive fringe product. Second, we would like to understand the impact of the no-surcharge rule on credit card customers, who are analogous to customers of the monopolist's product. We will find that the restraint harms cash purchasers and may or may not harm credit card customers.

[16] 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 equilibrium. Another solution to avoid the Prisoners' Dilemma is for the suppliers to lobby for a law that prohibits the use of vMFNs, as happens for example when states forbid credit card firms from using no-surcharge restraints.

[17] The term "competitive fringe" is normally used in models where the competitive firms and the monopolist produce the identical good. Here the competitive fringe and the monopolist produce differentiated goods.

The economic logic necessary to address the two questions requires a sequence of models. We start by examining these questions in a model that changes only the upstream market structure, compared to the duopoly model of the previous section. The market structure downstream is retained, as is the must-carry assumption (see the first two rows of Table 1 below). Under this assumption, we'll find that the power of the monopolist to leverage its market power to the entire market is strong. The power derives from the fact that the monopolist's product is (by assumption) essential for the retailers.

Relaxing the must-carry assumption (row 3 of the table) allows us to investigate the limitation imposed on the leverage strategy by retailers' option to drop the monopolist's product. Allowing this option and maintaining the assumption of a competitive market structure downstream would, as we discuss below, rule out the vMFN entirely as a profitable strategy. It follows that a theory of a vMFN allowing the monopolist to be disciplined by retailers' option to drop its product must recognize retailer market power. This leads to the third and final model of the vMFN in a monopoly - competitive fringe setting (the last row of the table). We find here that the ability of the monopolist to leverage its monopoly power over the entire market is profitable under some conditions. But the profitability of leverage, and the price charged under the vMFN, are disciplined in an interesting way. The monopolist offering a vMFN wants to elicit (accept, accept) as Nash equilibrium decisions by the two downstream retailers. By definition, this means that the participation constraint of each retailer must reflect the opportunity cost of *unilateral* deviation from the (accept, accept) equilibrium through rejection of the contract offer. This opportunity cost is higher, the higher the retail price that the monopolist implements via the vMFN because the deviating retail makes more profit facing a rival retailer charging a higher price. The monopolist can lower this opportunity cost, and therefore lower the share of rents that must be left with each retailer, by reducing its wholesale price and the resulting retailer price. This leads to an optimal strategy, when the vMFN is adopted, of eliciting a price that is lower than would be set by a full industry monopolist. Leverage is incomplete in this sense.

Market Structure Upstream	**Market Structure Downstream**	**Must-carry Assumption?**
Duopoly	Competitive	Yes
Monopoly-Fringe	Competitive	Yes
Monopoly-Fringe	Competitive	No
Monopoly-Fringe	Duopoly	No

Table 1: Structure of Vertical MFN Models

3.1 Incentives for a vertical MFN under the must-carry assumption with competitive retailers

3.1.1 Assumptions

We begin by changing only the upstream market structure of the previous model. A single firm supplies product 1 and considers a vMFN. 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 that they yield concave profit functions. The cost of producing product 1 is c and the competitive good is for simplicity available at zero cost.

The retail market is unchanged from the model of the previous section. Retailers must carry both products and consumers are fully informed. Given a wholesale price, w, this yields retail equilibrium prices $(p_1, p_2) = (w, 0)$ in the absence of a vMFN, and the lowest common retail price p that yields zero profits if a vMFN 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 vMFN restraint that $p_1 \leq p_2$.

3.1.2 Incentives for the vertical MFN

The profit that the monopolist earns in this model from any contract is equal to the total industry profits achieved under the contract: all other firms, upstream and downstream, are competitive, so 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 the optimal *target*, here (p_1, p_2), an approach followed in some of the early 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 vMFN restraint) or maximizing $\Pi(p_1, p_2)$ subject to $p_1 = 0$ (a no-vMFN restraint).

Proposition 5 *Under the monopoly-competitive fringe assumptions, and maintaining the assumption of must-carry, a vMFN 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 a vMFN 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 a stronger statement about the profitability of the vMFN:

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

The vMFN achieves the maximum industry profits because the vMFN constraint (p_1, p_2) is not binding when demand is symmetric. We have $\Pi(p^*, p^*) = 2\Pi^1(p^*, p^*) > 2\Pi^1(p^*, 0) = 2\max_p \Pi(p, 0)$. Imposing the vMFN and leaving the retail price of good 1 unchanged more than doubles profit.

Symmetry of demand is not necessary for the use of the vMFN 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* $a > 0$. *That is, the elasticity of demand is the same for the two products at any common price. Then the vMFN 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 vMFN 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 vMFN constraint $p_1 = p_2$ is not binding in maximizing Π.

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

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

3.1.3 The Impact of the vertical MFN on Prices

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 vMFN because under symmetry of demands only half of any wholesale price w is passed on. In fact, under a standard assumption, the prices of both products rise. Assume that Π is concave and that $\Pi(p_1, p_2)$ is supermodular, i.e., that $\Pi_{12} > 0$. [18] To investigate the impact of the vMFN 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:

$$\begin{aligned}\frac{d\Pi(p,p)}{dp}\rfloor_{p=p^*} &= 2\frac{d\Pi^1(p,p)}{dp}\rfloor_{p=p^*} = 2\Pi_1^1(p^*,p^*) + 2\Pi_2^1(p^*,p^*) \\ &= 2[\Pi_1^1(p^*,0) + \int_0^{p^*} \Pi_{12}(p^*,s)ds + \Pi_2^1(p^*,p^*)]\end{aligned} \tag{8}$$

Of the three terms inside the square bracket in the second line of (8), 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 vMFN. 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 the vMFN is imposed.*

With asymmetric demand, on the other hand, the price to consumers of the monopoly good may decrease when the vMFN 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 vMFN restraint.*

This proposition follows from simple application of the Lerner equation. It implies that with a more elastic demand for the competitive good, a vMFN 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.

[18] 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.

3.2 Endogenizing retailers' decisions to carry the products

To this point, the monopoly-competitive fringe model has focused on the role of the vMFN in leveraging monopoly power from the monopolized good to the competitive sector. The role of the vMFN has been to suppress one dimension of competitive discipline: the ability of consumers to switch to another product. The model offers a theory of the incentives for the vMFN as exploiting the must-carry feature of credit cards, a feature testified to by retailers in numerous credit card cases. Under some conditions, however, the model with the must-carry assumption gives too much power to the monopolist to be plausible. 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 Section 2): the ability of retailers to drop the product when a firm imposes a vMFN along with a large increase in the wholesale price that the vMFN entails.

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

Proposition 10 *In the monopoly - competitive fringe model, including the assumption of perfect competition among retailers, if the must-carry assumption is relaxed, the incentive for a vMFN disappears.*

The proof 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 vMFN's. We explore below the incentive for a monopolist to leverage vMFN's in a model that recognizes retailer differentiation and retailer market power.

3.2.1 Assumptions

We retain the assumptions on the upstream market structure. A single firm supplies product 1 and considers imposing a vMFN on its retailers. Competitive firms provides product 2, which is an imperfect substitute for product 1. The cost of producing either product remains equal to 0.

Downstream, two retailers compete as differentiated duopolists. Denote the price of product i at 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 elasticity of demand q^{ij} is increasing in p_{ij}. The monopolist's contract offered to each retailer j includes a two part price,[19] (w, F), and possibly a vMFN contract, $p_{1j} \leq p_{2j}$.

We consider the following game:

1. The monopolist offers a contract to each retailer.[20]

2. The retailers simultaneously decide whether to accept the contract offers.

3. Retailers set prices. A retailer that has accepted a non-MFN contract sets the prices for each good; a retailer that has accepted a vMFN contract sets a common price for both goods;[21] and a retailer that has rejected a vMFN contract carries only the competitive product and sets the price for that product alone.

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

3.2.2 Equilibrium

Lemma 1 *Under the assumptions listed, including symmetry in particular, it is feasible for the monopolist to offer a vMFN contract (with w at the appropriate value and fixed fees sufficiently low) that will elicit the price, p^*, that maximizes total industry profits.*

Total industry profits can be expressed as a function $\Pi(p) = [q^{11}(p) + q^{12}(p)](p - c) + [q^{21}(p) + q^{22}(p)]p$. Under the symmetry assumptions, industry profits are maximized by a price p^* for both goods at both retailers; this maximum industry profits are realized when p^* is established by both retailers for both products. The manufacturer simply sets w under a vMFN contract to the level that ensures each retailer's best response to p^* on the part

[19] 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.

[20] The contracts are public.

[21] In the assumption that the vMFN is always binding, we are ruling out the possibility that the competitive good is sufficiently inelastic in demand that the optimal retail price is lower for the monopoly good than for the competitive good.

of the rival retailer is p^*. That is, the industry maximizing wholesale price, w^*, satisfies the following condition at $p = p^*$:

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

Fixed fees are set at any value sufficiently low as to induce retailers to accept the vMFN contract.

While it is *feasible* to use a vMFN to leverage monopoly power completely, in the sense of eliciting the monopoly price for both goods instead of just one, it is never *optimal* to do so. The optimal variable price, when the vMFN 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.

When retailers have the option of of selling only the competitive good, as we are assuming in this section, 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 the vMFN, 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 the vMFN, since the no-MFN price to the monopoly good (given the demands are independent and identical) is p^*.[22]

[22] We prove the proposition under the assumption that the vMFN contract elicits a pure strategy equilibrium. (It is standard in models of vertical control with Bertrand competition to focus on pure strategy equilibria.) 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.

Proposition 11 *Suppose that in the monopoly - competitive fringe model demands are identical for the two products and independent. Any optimal use of the vMFN restraint that results in a pure strategy equilibrium will increase the price for the competitive good, and reduce the price of the monopolized good, to a common price that is less than the price that would be charged by a hypothetical industry monopolist.*

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. The vMFN contract here fails to fully coordinate the supply chain (which would require fully horizontal leverage of monopoly power) because of the endogeneity of each retailer's required compensation to meet the participation constraint to accept the vMFN contract.[23]

4 Application to the No-surcharge Rule in Credit Card Markets

The application of our theory to the no-surcharge rule in credit cards may appear to be immediate. A credit card, after all, is a service offered by upstream credit card companies, with the participation of issuing banks. A wholesale price is charged to merchants for the right to offer the use of a credit card – and a credit card surcharge is the price that a consumer pays at retail for using the credit card service. A no-surcharge rule *is* a vertical MFN. We shall conclude that the theory does indeed apply directly. But in doing so we must evaluate the proposition in the credit card literature that because a credit card network is a two-sided market, conventional antitrust analysis does not apply. This view is ubiquitous and was at the heart of the successful appeal by American Express of the district court decision in *U.S. v. Am. Express Co.* We show that this view is wrong.

We proceed by reviewing the flow of funds in a credit card network. The central fee in this flow of funds is the interchange fee, which is paid by the merchant's bank to the issuing bank per dollar of transaction on the credit card. We outline the two-sided market view of credit cards dominant in the literature. The two-sided theory is formulated in terms of a profit-maximizing credit card company setting one price to the acquirer/merchants and one price to

[23] This section leaves a basic unanswered, to this point. Will the drop in industry profits below maximum industry profits under the vMFN, resulting from the retailers' participation constraints, be so large as to render the vMFN unprofitable? That is, is a vMFN profitable for a monopolist facing a competitive fringe, as well as duopoly retailers downstream with freedom to drop the monopolist's good? We address this question in an online appendix for the case of linear demand.

issuer/cardholders. Maintaining the assumption of a profit-maximizing credit card company, we then interpret the credit card flow of funds in terms of a conventional vertical setting. We then show that the economic principles developed in the literature regarding the two-sided nature of credit card networks, such as the characterization of the optimal interchange fee as output maximizing, are simply reformulations of principles developed for standard one-sided markets. The implication is that competition policy in credit card networks does not in fact require a new economic framework. We strengthen this conclusion by offering an alternative and simpler perspective on credit card cash flows – that the credit card service is offered jointly by the credit card company and the issuer, with parameters set to maximize the joint profit of these two agents.

4.1 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 those owned by Visa and MasterCard.[24] 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 Figure 2 typical values for the fees associated with a \$100 transaction.[25] We assume in this figure 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

[24]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

[25]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, Carlton 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 transaction 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.

acquirer pays a network fee of \$0.06 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 with a small fee \$0.05 to cover the acquirer's cost.[26] 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.

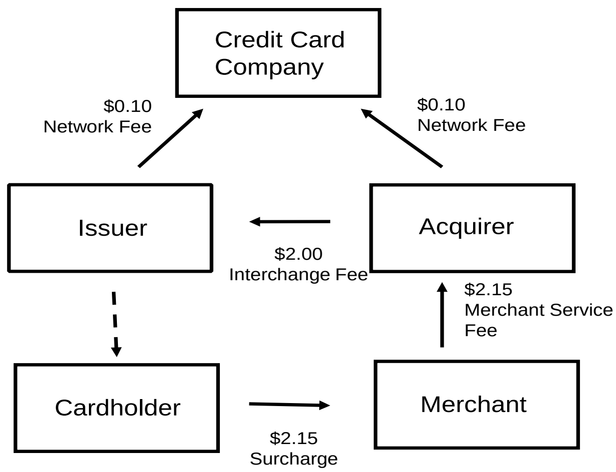

Figure 2:

Flow of Funds in a Credit Card Transaction with Surcharge Fees

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.

4.2 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

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

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 to the acquirer a fee $m = f_1 + a + g$.

The issuer price, $f_1 - a$, is negative. It is used to finance promotion and cardholder benefits, including air miles, travel insurance, the basic service of offering zero-interest credit for bills paid on time, and possibly cash-back awards. The two-sided market approach to credit card networks postulates that the demand for credit card services, as measured by the total dollar value of transactions can be written as[27]

$$q(p_1, p_2) = q(f_1 + a, f_2 - a) \tag{9}$$

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 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 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:

$$\pi = (f_1 + f_2 - c) \cdot q(f_1 + a, f_2 - a) \tag{10}$$

where c is the cost to the credit card company per dollar of transaction. The demand function (9) is assumed to yield a strictly concave profit function.

The separability of this profit function implies immediately that the profit-maximizing value of the interchange fee, a, maximizes quantity, i.e. the volume of transactions, given the network fees:

Proposition 12 *At given values for the network fees, $f_1$and f_2, the profit-maximizing interchange fee, $a*$, maximizes the volume of transactions, $q(f_1 + a, f_2 - a)$.*

The credit card company must balance prices on two sides of the market, in order to maximize

[27]Note that this reduced-form expression of demand encompasses the endogeneity of the number of merchants offering the credit card as well as the dependence of demand, on each side of the market, upon the number of agents joining the network on the other side of the market.

quantity, which it will do whatever it its level of market power.[28] 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. In other words, as the literature has stressed it is wrong to focus only on the level of total fees, $f_1 + f_2$. Instead, one must also the consider relative prices on each side of the market. Indeed,as we explain below, that is the essence of a two-sided market.(Rochet and Tirole(2006)).

Maximizing output with respect to the interchange fee, holding network fee constant, yields the following necessary condition for the optimal interchange fee.[29] Let ε_1 and ε_2 be the elasticities of q with respect to p_1 and p_2 .

$$\frac{\varepsilon_1}{p_1} = \frac{\varepsilon_2}{p_2} \tag{11}$$

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 literature makes clear, and we agree, a business practice such as the no-surcharge rule, will affect both sides 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 ... is to maximize payment system output rather than to exercise market power by restricting output." Klein et al, p.575.

Because the claim of a two-sided credit card market is so central to policy in this area – especially to the *Amex* decision – we elaborate on the *sense* in which a credit card network is a two-sided market. The literature identifies three elements as together characterizing

[28]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.

[29]See, for example, Emch and Thompson (2006).

two-sided markets or platforms:[30]

- The platform intermediates transactions between two distinct groups of agents;
- There are indirect externalities, in the sense that the value of the platform increases with the number of agents on the other side;
- The price structure is non-neutral in the sense that an increase in the price on one side of the market combined with equal decrease in the price on the other side of the market affects demand. That is, demand depends on the price *structure,* not just the total price.

The first two of these elements are the basis for the common description of a credit card network as a two-sided market, with merchants on one side of the market and issuer/cardholders on the other side. The indirect externalities requirement applies, since the more merchants sign up to the credit card network, the more valuable the network is to cardholders and vice versa. These two elements, however, are inadequate as a definition of two-sided markets in general because these conditions alone would leave us with a concept of two-sided markets that is too broad. In any market with product differentiation among sellers, buyers are better off with more sellers and sellers are better off with more buyers. And any retail market would be a two-sided platform. The distinguishing feature of a two-sided market, due to Rochet and Tirole (2006) is that the structure of the prices to the two sides matter.[31] This condition rules out a conventional market in which a price increase (or tax) on buyers is offset exactly by a price decrease (or subsidy) on sellers, and vice versa.[32]

4.3 Neutrality of the Interchange Rate

Whether or not a credit card market is two-sided – with a focus on the Rochet-Tirole condition that the price structure must matter – is tied closely to the issue of whether or not the interchange fee is neutral. This issue is prominent in the credit card literature (Carlton and Frankel (1995), Gans and King (2003)). Referring to the demand function (9), the

[30] The OECD (2009) report, p.11, offers a particularly clear summary.

[31] To express this another way, a two-sided market is characterized by the failure of the theorem from public finance that the incidence of a tax is independent of which side of a market pays the tax.

[32] We are sympathetic to the view of Weyl (2010) that two-sidedness of markets represents a style of modeling in industrial organization more than a precise definition to be applied to markets. But we delve into the definition of two-sided markets because the *Amex* appellate court decision depends categorically on the court's requirement for an anticompetitive impact in two sided markets.

market is two-sided only if a change in the interchange fee a has an impact on demand. If not, the interchange fee is neutral and the market is not two-sided in the Rochet-Tirole sense.

But *when* will the interchange fee be neutral? To address this question, we must go beneath the reduced-form expression of demand to the structure of a full pricing game, in which the issuer and merchants, not just the credit card company, are decision makers. Consider the following game, which we refer to as the "structural credit card model". The players are the credit card company, the issuer and merchant.[33] Demand for transactions by credit cardholders depends on the surcharge s set for the credit card, expenditure (per dollar transaction) in a number of dimensions of promotion by the issuer, $x = (x_1, ...x_n)$, and the retail price p set by the merchant for the product being sold. The dimensions of promotion represent cardholder benefits as well as general advertising. Demand for credit card is $\hat{q}(s, p;\, x_1, ...x_n)$. The merchant can transact with cash as well: the demand for cash transactions is $\hat{q}_c(s, p;\, x_1, ...x_n)$. The issuer sets parameters (f_1, f_2, a). The acquirer market is assumed to be competitive with (for simplicity) zero costs, so that the merchant fee equals the acquirer fees, $f_2 + a$. The merchant thus faces a wholesale charge $f_1 + a$ per dollar transacted on credit cards and an exogenous wholesale price w for product. The merchant sets p and s. The entire set of endogenous parameters is thus $G = (f_1, f_2, a, x, p, s)$ The payoffs for the credit card company v (for Visa), the issuer I and the merchant m are given by

$$\pi_v(G) = (f_1 + f_2)\hat{q}(s, p;\, x_1, ...x_n)$$

$$\pi_I(G) = (a - f_1)\hat{q}(s, p;\, x_1, ...x_n) - (\Sigma_i x_i)\hat{q}(s, p;\, x_1, ...x_n)$$

$$\pi_m(G) = (p + s - w)\hat{q}(s, p;\, x_1, ...x_n) + (p - w)\hat{q}_c(s, p;\, x_1, ...x_n)$$

The timing of the game is as follows. The credit card company sets the parameters (f_1, f_2, a). The issuer then sets the vector of promotions, x, and finally the merchant sets the price and surcharge values, (p, s). We adopt the usual equilibrium concept of subgame perfection, and assume that at least one equilibrium exists.

The key condition for neutrality of the interchange fee is that there be a dimension of promotion, say x_1, that is a perfect substitute for a price reduction in demand. The natural interpretation of $x_1$is a cash back bonus; the condition is that a cardholder regards a 1 percent cash back on purchases as equivalent to a 1 percent reduction in the surcharge. Formally, we label the following assumption as the *perfect cash-back assumption:* in the structural credit

[33] We take the number of merchants (1) as exogenous. A model of a credit card network with endogenous merchants would yield the same neutrality result.

card model, demand satisfies, for any Δ, $\hat{q}(s+\Delta, p;\ x_1+\Delta, ...x_n)$= $\hat{q}(s, p;\ x_1, ...x_n)$.

Proposition 13 *Under the perfect cash-back assumption, if* $G^* = (f_1, f_2, a, (x_1, ...x_n), p, s)$ *is an equilibrium, then the following is an equilibrium with equal payoffs:* $G^* = (f_1, f_2, a + \Delta, (x_1 + \Delta, ...x_n), p, s + \Delta)$*.*

The interpretation of this proposition is that if the credit card company changes the interchange fee by, say, 10 basis points, then all players in the game will adjust their prices to leave demand and payoffs unchanged. The proposition intuition for this result follows the repeated application in the credit card network of Figure 1 of the principle that the impact of a tax on a transaction is independent of which party pays the tax. An increase in the interchange fee by 10 basis points is a tax on the acquirer of 10 basis points, which is equivalent to a tax on the merchant of 10 basis points, which in turn is equivalent to a tax on the customer of 10 basis points. The interchange fee also provides the issuer with a per-unit subsidy of 10 basis points. But under the condition of the proposition, the issuer will pass this through completely in the form of a 10 basis point increase in $x_1$since this will leave the marginal profit of the issuer unchanged in all dimensions of x. The consumer, facing a 10 basis point increase in the surcharge from the merchant and a 10 basis point increase in the cash-back, x_1, from the issuer, will demand the same quantity. The proof of interchange neutrality in Gans and King (2003) tracks this intuition. Our proof, in the appendix, is very short as a direct application of a property of any game: a transformation on the collective strategy space that preserves the payoff of each player in a game also preserves the set of subgame perfect equilibria.[34]

Note that the Rochet-Tirole definition of a two-sided market can be expressed as one in which the perfect cash-back assumption fails.The proposition raises the question of why in reality the interchange fee is relevant, even in jurisdictions where surcharging is allowed, since the assumption that a consumer be left indifferent with a change in the surcharge and an offsetting change in cash-back benefit at the end of the month seems so benign. One answer is from behavioral economics. Evidence shows that posted prices are more salient in consumers' choices of prices gross of tax (Chetty et al, 2009). The same empirical result would surely follow with prices net of subsidies, the subsidies to be paid at the end of the month.

[34]Mathematically, the profit function under the condition of the proposition fails the strict concavity assumption of the reduced form model since along the ray in the parameter space formed by $(s+\Delta$,$x_1+\Delta)$ as Δ varies, profit is constant. This is why we can get neutrality of a in the structural model, but a unique optimum a in the alternative, reduced form model.

We believe that the two-sided market model, while internally consistent, is misleading in two respects. First, *even if* we adopt the assumption that the fees are chosen to maximize credit card company profits, with the interchange fee balancing the two sides of the market, the economic structure of the two-sided model are logically equivalent to the structure of a conventional market with promotion.The two-sided model therefore offers no theoretical justification for adopting a different set of antitrust rules for the credit card market than for any one-sided market. (As we will see below, however, this is exactly what a U.S. Court of Appeals did in a recent major antitrust decision.) Second, we are skeptical of the empirical validity of the interpretation that interchange rule balances the two sides of the market and suggest instead a simpler role for the interchange rate. We develop alternative theories of credit card flow of funds in the next two subsections.

4.4 Interpreting credit card network flow of funds in a vertical framework

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 vMFN theory to credit card no-surcharge rules?

The description of the credit card flow of funds as those of a two-sided platform as opposed to a service offered by an upstream firm through a retailer is taken to be fundamental in policy discussions and as we shall discuss is pivotal in the *Amex* appellate court decision. But the distinction is purely one of labeling cash flows. We show in this section that the principles developed in the two-sided framework – that the interchange fee balances the two sides of the market in a way that maximizes volume of transactions – are simply a reformulation of economic principles established in the conventional vertical framework. This is important for two reasons. It means that our theory of the vertical MFN as anticompetitive applies directly. Nothing in the labeling of credit card networks as two-sided markets or platforms changes this. And as we shall discuss it means that the Amex decision on special antitrust treatment of vertical restraints in credit cards on the basis of two-sided markets is without economic foundation.

4.4.1 Credit card parameters as maximizing profit of the credit card company

We start with the conventional assumption that the fees in the network are set by the credit card company to maximize its profits. This is the assumption underlying the interpretation of the interchange fee as balancing the prices on the two sides of the market so as to maximize volume, as outlined in the previous section. Under this assumption, the difference in labels between the two-sided market approach and the conventional vertical approach is summarized in the first two rows of Table 2. Viewed in a vertical setting, the total fees charged to the merchant through its intermediating bank, $a + f_2$, is the wholesale price of the credit card service offered at the retail level to consumers. And the interchange fee net of the issuer network fee, $a - f_1$, is simply the portion of the wholesale price (or portion of the total credit card company revenues) allocated by the credit card company to promotion. Two aspects of this expenditure on promotion might initially appear to be unusual but on further analysis are not. The promotional expenditure is decentralized, being assigned to the issuer rather than incurred directly by the credit card company;[35] and the payment to issuers is made directly by the merchant's bank rather than allocated by the credit card company from revenues received. Neither of these is significant in terms of the validity of a vertical interpretation. Promotion is often decentralized in markets. And the fact that the payment to the issuer comes directly from the merchant bank rather than spending a millisecond in the accounts of the credit card company is irrelevant.

[35]Credit card companies of course engage in some promotion directly, but these expenditures are not relevant here.

	Interpretation of Credit Card Network Parameters	role of $a + f_2$	role of $a - f_1$
1	Two-sided market, parameters maximizing credit card company profits	price to merchant	(negative of the) price to issuer
2	vertical theory, parameters maximizing credit card company profits	wholesale price	promotion per dollar transaction
3	vertical joint-supply theory, parameters maximizing joint profits of credit card company and issuer	wholesale price	issuer's share of revenue per dollar transaction

Table 2: Three Theories of Credit Card Network Fees

Our focus on the semantics of the two-sided market versus conventional one-sided, vertical interpretation of credit card cash flows is designed to emphasize that regardless of the language used to describe the flow of funds in a credit card network, it s the flow of funds itself, not the terminology, that matters. This is important because the precise language *has* mattered for the law in this area, as our discussion of the *Amex* decision in the next section of this paper makes clear. If antitrust law on vertical restraints is categorically different between a one-sided market and a two-sided market, for example, then a firm imposing vertical restraints in a one-sided market might well be able to change its structure slightly (perhaps by decentralizing promotion), claim status as a two-sided market, and then be subject to a more relaxed set of antitrust rules.

Since the fees in a two-sided model of the credit card service market can be interpreted in terms of a conventional vertical or supply-chain setting, it follows, as we explain below, that the economic principles claimed as novel for credit card theories – such as the principle that interchange fees are optimally chosen to maximize output – must simply be reformulations of principles already established for conventional one-sided markets.[36]

[36]Our work is related to other work (e.g., Liebowitz and Margolis(1994) and Alexandrov and Spulber(2016)) questioning the sharp distinction between insights from two-sided ness versus one-sidedness.

The optimal interchange problem is simply a variant of the Dorfman-Steiner problem: In the two-sided theory the role of the interchange fee is to balance prices on the two sides of the market. At the optimal, volume-maximizing interchange fee, the balancing condition (11) holds. In the vertical theory (theory 2 of Table 2) 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. Dorfman and Steiner (1954) posed the following problem. How should a firm choose price,p, and total promotion (or quality - the problem is the same), A, in order to maximize profits when demand depends on price and total advertising The optimal expenditure on promotion as a ratio of revenue is given by the Dorfman-Steiner (1954) theorem:

$$\frac{A}{pq} = \frac{\eta_A}{\eta_p} \tag{12}$$

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. With the elasticities so defined, we have the following.

Proposition 14 *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 this is the same problem as choosing the optimal portion of total revenue to devote to promotion. The "optimal interchange fee" is a garden-variety problem of how much to promote, a problem faced by any firm in any market. The solution is no different for a credit card company than for any other firm. The economics of the credit card interchange fee, under the theory that credit card company profits are maximized, are simply the Dorfman-Steiner theory with new notation.

We now show that the Dorfman-Steiner problem in *any* market can be formulated in terms of volume maximization. The quantity-maximizing property of the optimal interchange fee is not a unique feature of 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. Denote $x \equiv p - a - c$. 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. Solving the problem leads to the following.

Proposition 15 *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. Solving this output-maximizing problem yields the Dorfman-Steiner theorem.*

Formulating Dorfman-Steiner as volume maximizing is just a matter of a change in variables to hold constant the right prices. 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 increases quantity. (The net revenue per unit is unchanged with the exercise of this option, so profits increase if and only if quantity increases.) The exercise is simply another way of formulating the Dorfman-Steiner trade-off faced by any firm. And this trade-off is precisely that undertaken by a credit card firm in selecting optimal interchange fee.

4.4.2 Credit Card Network Parameters as maximizing the Joint Profit of the Credit Card Company and Issuer

Both the two-sided market theory and our equivalent vertical theory are driven by the assumption that the credit card company chooses fees to maximize its profit. The role of interchange is to balance the two sides of the market, or equivalently (and this is our point) to balance between price-cutting and promotion as two instruments to attract demand. A third theory is simpler: that credit card services are offered jointly by the credit card company and the issuer. The role of interchange is to provide the issuer with its negotiated share of total revenue: the wholesale price, $a + f_2$, is shared between the issuer and credit card company, in amounts $a - f_1$and $f_1 + f_2$. These shares reflect both the marginal costs to the joint suppliers of the components of the service that they provide, as well as a split of the quasi-rents according to the value of assets that the parties bring to the venture. [37]

[37] In practice the terms of the credit-card issuer contract tend to be set by the credit card company, rather than negotiated separately with every issuing bank. This does not confer bargaining power on the credit card company, but merely reflects the efficiency of having standard-form contracts for each credit card company.

This perspective resolves an empirical difficulty with credit card company-centric theories of the market for credit card services. Consider the fee values illustrated in Figure 3, which are chosen to be realistic in current or recent markets. Interpreted in terms of the theory outlined above, the fraction of revenue that the credit card company allocates to promotion is $(a - f_1/a + f_2) = (210 - 10/210 + 10) = 0.9$. The ranges of elasticities that support the strategy of devoting 90 percent of revenue to promotion are extreme. To put this in the simplest terms, a credit card company could, holding promotion constant, triple f_2 from 10 basis points to 30 basis points. This would double its revenue per unit, $f_1 + f_2$, from 20 to 40 basis points. But this would add only $20/215 = 9$ percent to its wholesale price to merchants. There would be little change in demand at merchants that continued to carry the card, since these merchants would pass on the 10 percent increase in credit card fees (which would be in the order of 1 percent of overall marginal cost) with a general product price increase in the order of 0.1 percent. For the tripling of f_2 from current values *not* to be profitable, in short, more than half of all merchants would have to abandon the card in response to a wholesale price increase of 10 percent.[38]

The joint-supply theory has no such difficulty. From this perspective, the 90 percent share of wholesale revenues that a issuer captures in a typical contract with a credit card company reflects the range of tasks that the issuer provides – cardholder benefits, the basic service of credit at zero interest rates within the month, the cardholder accounting and relationship – and, at least as important, represents quasi-rents on the key asset that the issuing bank brings to the table in negotiating rates with the credit card company. The bank's set of existing customers are a unique asset in that these customers are more likely to sign up for credit cards issued by their own bank rather than by other banks.The network provided by the credit card company, on the other hand, is not a unique asset in the sense that a big bank could switch its customers to another credit card company (Visa or MasterCard). It is unsurprising, from the perspective of credit card services as supplied jointly by the credit card company and the issuer, that the issuer's share of revenue be so high.[39]

Note that we have excluded the acquirer as a partner in the joint supply of the credit card network. This does not deny the critical place of the acquirer in the network. The market for acquisition, however, is competitive - being provided by commercial banks and by dedicated acquisition-service providers, which provide a pure intermediary service capturing only a few basis points of the total fee charged to merchants.

[38] This would require a market elasticity of about 5 in merchant's decisions to honor the card. Such a high elasticity is hardly plausible even for an individual merchant let alone for the market, given the testimony by merchants in antitrust cases that Visa and MasterCard are "must carry" services.

[39] Prior to the incorporation of Visa and MasterCard in 2007 and 2008, the two networks were associations of issuers and acquirers. The ownership (rights to profits) by issuers of the supply of credit card services was explicit. Our point is that even after the incorporation, credit card services are supplied jointly by issuing banks and credit card companies in contracts that provides banks with the 90% or so of the revenue, reflecting the fact that it is issuing banks that provide both the majority of input tasks in a credit card network and bring the most valuable assets to the negotiating table.

4.5 The Impact of No Surcharge Rule

The distinction between the second and third theory of Table 2 will come up in our analysis of the law in the next section of this paper. But as a matter of economics, whether we take the perspective that the market for credit card services involves competition among credit card companies or competition among credit card company - issuer pairs, the impact of the no-surcharge rule on price competition at the wholesale level is the same. The no-surcharge rule is a vertical MFN, and the theory we offered in the first sections of this paper applies directly. Competition among credit card networks in a world with surcharges would lead to low wholesale prices for the service, compared to a world with no-surcharge rules. The elasticity of demand facing any credit card network would be high, because consumers making decisions on which transaction method to use for purchasing the identical product would be sensitive to differences in total prices. The no-surcharge rule not only suppresses competition among credit card networks, it renders the networks complements instead of substitutes, raising the prices even higher.[40]

The no-surcharge rule, following the monopoly-competitive fringe theory, allows a credit card company to extract surplus from cash customers. Under the no-surcharge rule, merchant must cover the cost of the credit card fee in the price for its products generally, including prices to cash customers. There are two offsetting effects on credit card customers as we move from a world of surcharges to a world of no-surcharge rules. The total price to these consumers may fall because the cost of the service that they consume is being paid for in part by cash customers. But the price may rise because of the cost-externalization effect, which provides suppliers of the credit card service with an incentive to raise the price. The option of merchants to drop a credit card provides an additional downward effect on price, because it disciplines the credit card network against raising its wholesale price under the no-surcharge rule. The merchant's option to drop the card may even be strong enough to deter the adoption of the rule.

The impact of the no-surcharge rule, as with any conduct that suppresses price competition,

[40] We note here a logical connection between the neutrality of the interchange rate, the neutrality of a no-surcharge rule, and the Rochet-Tirole definition of a two-sided market. Recall that the perfect cash-back assumption (which can be expressed as the assumption that the credit card network is *not* a two-sided market) is sufficient for the neutrality of the interchange fee. It is easy to demonstrate in a structural model extending that of section 4.3 that the perfect cash-back assumption is sufficient for the neutrality of the no-surcharge rule. The adoption of the no-surcharge rule by both firms in a duopoly has no impact under the perfect-cash back assumption, because the rule has no impact on best-response functions. Any change in price can be undone by an offsetting change in the cash-back benefit. This is simply an example of the principle that in any duopoly market in which firms have a dimension of promotion that is a perfect substitute for a price decrease, attempts to suppress price competition (via a specific contract, collusion, or other conduct) will fail.

raises the incentive for promotion. The marginal benefit of increased promotion, x, for a firm facing demand $q(p, x)$ with marginal cost c is $(\partial q/\partial x)(p - c)$. Conduct in *any* market that raises price-cost margins therefore raises promotion (defined generally as including advertising and promotion). Stigler (1964) developed this point in the context of collusion; firms that can collude on prices but not on promotion will exhaust some of the resulting rents through an increase in the intensity of non-price competition. But Stigler's proposition extends to any conduct or practice that suppresses price competition. The increased incentive for promotion, in short, is simply a by-product of the suppression of price competition.

5 Implications for Competition Policy

5.1 Background

In some areas of antitrust the presumption is that the elimination of price competition carries harm that will not be offset by any resulting increase in promotion. Price fixing, for example, is *per se* illegal, which means that a court will not credit the effects of the elevated price on promotion as a justification for the elimination of competition. The policy is based not on a theorem that price fixing is invariably against social interest, but rather on an empirical assessment that the costs of price fixing almost always outweigh the benefits.[41]

A vertical restraint such as the no-surcharge rule, however, is assessed under the rule of reason in U.S law. The law, to simplify, involves three stages in terms of the burdens of proof.[42] First, the plaintiff (the government in an antitrust case brought by the government) must demonstrate a restriction on competition. Second, the defendant must produce evidence of pro-competitive benefits of the restraint. Third, the court balances the pro-competitive benefits of the restraint against the competitive harm. This structure incorporates an informational efficiency: it elicits information about the benefits of the practice at issue from the party (the defendant) best positioned to provide that information.[43]

It is helpful to consider as a benchmark the application of the law to a more frequently observed vertical restraint, resale price maintenance. Resale price maintenance can be used for anti-competitive purposes, but the most common use of the restraint involves a firm imposing a price floor on its retailers to encourage promotion, greater inventory or sales

[41] As Scott Morton (2013, p.1) states, "the consensus among scholars and policy makers over many years is that any efficiency-enhancing aspects of ... a naked horizontal agreement are almost always swamped by anticompetitive effects."

[42] The legal basis for this framwork is provided in the *Amex* appellate court decision at pp. 30 - 32.

[43] The defendant is also likely to be best informed about the competitive harm of a practice, but there is no incentive-compatible mechanism that would elicit this information from the defendant.

effort in general. To summarize the incentive very briefly, given its wholesale price, w, an upstream supplier has the option of letting the downstream retail market determine the equilibrium retail price, p^*, or setting a retail price floor $\underline{p} > p^*$. Choosing a price floor raises the retail price by an amount $\underline{p} - p^*$, which is a cost to the upstream supplier since retail demand is downward sloping. But the practice carries the benefit of creating an incentive for greater downstream promotion or sales effort, since the retail margin is increased. The upstream supplier can benefit from the restraint if the increase in demand from the greater promotion exceeds the decrease in demand from the higher retail price. There are many possible explanations of why the unrestrained retail market would fail to yield the mix of price and non-price competition that would maximize the supplier's profit, being biased towards price competition and away from non-price competition. Prominent among these are free-riding explanations. If promotion by a retailer attracts customers to the product but not necessarily to its own outlet, then promotion may be vastly under-provided because of the positive externality in the retailer promotion decision. In this situation, a retail price floor may well increase total demand, given the supplier's choice of wholesale price.[44]

Resale price maintenance moved from per se illegality in U.S. law to rule of reason in the famous *Leegin* case in 2007.[45]In terms of the three stage procedure, the government's case in the first stage in a resale price maintenance case is immediate: the vertical price floor on its face prevents retailers from competing on price.[46] The evidentiary focus then shifts to the defendant who would explain that the resale price maintenance encouraged promotion that would not otherwise have occurred and thereby expanded sales. The court would then weigh the two effects, the pro-competitive benefits claimed by the defendant and the competitive harm claimed by the plaintiff. It is important to note that the burden on the plaintiff in the first stage involves the demonstration of only a dimension in which competition is restricted - not a *net* competitive harm from the practice. The determination of the net competitive effect of the restraint is for the balancing exercise of the court in stage 3 of the process.

In a resale price maintenance case, in which the restraint plays the role described of eliciting promotion, the significant impact of promotion on demand is immediate from the simple observation that the practice is observed. An upstream supplier would not tolerate the demand-dampening effect of a higher retail price were it not for the demand enhancement

[44]This is an extreme simplification of the theory of resale price maintenance, but enough for our purpose of setting out the contrast between resale price maintenance and vertical MFN's. For explanations of resale price maintenance as a response to retail market distortions beyond traditional free-riding, see Klein (2009), Winter (1994), Krishnan and Winter (2007). Klein and Murphy (1986) develop the role of resale price maintenance as protecting not just retail margins but rents at the retail level. Rents enhance the power of the upstream supplier to ensure retailer promotion through monitoring.

[45]*Leegin Creative Leather Prods., Inc. v. PSKS, Inc.*, 127 S. Ct. 2705 (2007)

[46]cite to Leegin

effect of greater promotion. The price effect is a *cost* to the upstream supplier.

Not so for a vertical MFN. With this restraint, the price effect itself is a *benefit* to the upstream supplier implementing the restraint. The price effect stems from the suppression of horizontal competition across suppliers upstream, and the price effect alone is enough to explain the use of the restraint. The increased promotion resulting from a vertical MFN is closer to case of horizontal price-fixing than it is to the typical vertical restraint case. We suggest that at a minimum this should mean that in balancing any pro-competitive versus anti-competitive effect of a vertical MFN, the courts should require stronger evidence that induced promotion is important in order to find for the defendant.

5.2 *United States v. American Express Co.*

The restraint at issue in *American Express* was broader than a no-surcharge rule. The restraint was a no-steering rule that any method by retailers to steer customers to use other credit cards or transactions methods, whether by surcharging Amex cards or persuading consumers to choose alternatives to Amex cards. As a matter of economic theory, the no-steering rule has the same impact as the no-surcharge rule as analyzed in this paper in suppressing price competition. Consistent with this theory, the district court found that the plaintiff, the U.S. government, had met the legal test of demonstrating competitive harm from the no-steering rule.

> "[B]y preventing merchants from steer additional charge volume to their least expensive network, for example, the NDPs [non-discrimination provisions] short-circuit the ordinary price-setting mechanism in the network services market by removing the competitive 'reward' for networks offering merchants a lower price for acceptance services. The result is an absence of competition among American Express and its rival networks." (*AmEx* I at 150.)

The district court went on to consider, and reject, various free-riding defenses for the no-steering restraint that Amex had put forth in its attempt to convince the court that there were pro-competitive justifications for the no-steering rule, the second stage of the typical vertical restraint case.[47] Thus the district court based its decision on a finding that after

[47] We mention two arguments here, and refer to the decision for more details. AmEx proposed that NDP's prevented free-riding on analytics-based services that it provides to merchants. The court responded correctly that AmEx "can – and does – price and sell these ancillary benefits separately from its core network services." (*AmEx* I at 145). AmEx also argued that merchants derive a benefit from the association of their brand with that of American Express when they advertise or promote that they accept AmEx cards, a phenomenon knows as "credentialing". Since this is a theory that could potentially be brought by any supplier selling

the plaintiff (the United States) had shown a restriction on competition, Amex had failed to meet its burden to provide a pro-competitive justification that the court could then balance against the competitive harm.

Amex's defenses were irrelevant to the appellate court, because the appellate court overturned the decision at what we have termed the *first* stage of the legal procedure. The appellate court rejected the district court's decision that the Amex's no-steering restraints harmed competition. The appellate court ruled that the district court had erred in requiring the government to initially show that only retailers were harmed by the no-surcharge rule. A proper antitrust analysis, according to the appellate court, must "consider the two-sided *net* price accounting for the effects of the [restraints] on both merchants and cardholders."[48][emphasis added] The appellate court stated:

> "This analysis erroneously elevated the interests of merchants above those of cardholders... Plaintiffs bore the initial burden to show that AmEx's NDPs have 'an actual adverse effect on competition as a whole in the relevant market.' ... Here, the market as a whole includes both cardholders and merchants, who comprise distinct yet equally important and interdependent sets of consumers sitting on either side of the payment-card platform. The NDPs simultaneously affect competition for merchants and cardholders by protecting [against competition from other means of payment] the critically important revenue that AmEx receives from its relatively high merchant fees. The revenue earned from merchant fees funds cardholder benefits, and cardholder benefits in turn attract cardholders. A reduction in revenue that AmEx earns from merchant fees may decrease the optimal level of cardholder benefits, which in turn may reduce the intensity of competition among payment card networks on the cardholder side of the market". [*AmEx* II at 54, footnote deleted]

That the higher prices resulting from the no-steering restraints harmed only merchants and, through the funding of greater cardholder benefits, helped only cardholders is fallacious. The issue in assessing the no-steering restraint is not merchant harm versus cardholder benefit; it is simply a matter of higher prices versus greater product quality or promotion. A higher price charged to merchants is always passed on to some extent to consumers, including both cardholders and - especially where surcharging is not practical– to consumers using cash

through retailers, to justify any practice that suppressed price competition; we would suggest, the evidentiary standards of proof should be high. The court considered the free-riding theory, but found on the basis of evidence before the court that the argument was without merit (*AmEx* I at 149). Amex's own survey data indicated that cardholder perceptions of merchants honoring AmEx trails those of its competitors.

[48] *U.S. v. Am. Express Co.*, 2016 WL 5349734 (2d Cir. Sep. 26, 2016) at 54

and other means of payment. The higher price is passed on *completely* if retail markets are competitive. (Competitive retailers is not a bad approximation and in any case the court did not rely on retailer market power.) Consumers, not just merchants, faced higher prices as a result of the no-steering restraint. Higher cardholder benefits do result from the suppression of price competition – not because more revenue is available to fund the benefits but because in any market where competition is suppressed, incentives for non-price competition increase (Stigler (1964)).[49] The competitive assessment of Amex's no-steering restraint should be no different than the assessment of any practice that eliminates price competition among upstream suppliers, thereby raising prices and – as a secondary effect – raising quality and promotion.[50]

The appellate court erred in claiming that it was the plaintiff that had to show in the initial stage that the restraint on competition was a net harm to customers and retailers. The appellate court did not even allowing the matter to get to the balancing exercise because it rejected the district court's ruling that the price impact of the restraint constituted an adverse impact on competition. The no-steering rule in fact does restrict competition in suppressing price competition; this conclusion has even stronger the finding (accepted in law) that resale price maintenance restricts competition because under the no-steering restraint it is price competition among upstream suppliers that is suppressed. If the appellate court had recognized the supression of price competition as an adverse competitive effect, allowing the process to proceed to the balancing exercise, then it would have upheld the lower court's decision, since an appellate court does not reexamine matters of evidence.

The appellate court's reliance on the concept of a two-sided market or platform in its decision ruling in Amex leaves us with a different antitrust standard for examining vertical restraints in one-sided versus two-sided markets. There is no economic basis for a difference in standards between two-sided and one-sided markets. And under a broad definition of two-sided markets, even a conventional retailer can be interpreted as a two-sided platform – meaning that Amex is a potentially far-reaching change in antitrust law on vertical restraints.

6 Conclusion

The wide set of theories developed in this paper support two general conclusions. First, a vertical MFN is anticompetitive in both suppressing competition between duopolists and in

[49] And if we are to allow for retailer market power, then retail merchants benefit as well from cardholder benefits because of the increase in demand. Again, the issue is the impact of the practice on prices versus product quality – not the impact on merchants versus cardholders.

[50] Upstream suppliers against which Amex competes are not just other credit cards but also other means of transaction, such as cash or debit cards.

allowing a dominant firm to leverage its market power over a competitive fringe.[51] Second, the theory applies directly to the no-surcharge rule in credit card markets notwithstanding the two-sided nature of credit card platforms.

The two-sidedness of credit card markets does not require a new set of economic principles for assessing competition policy because the difference between the credit card setting and a conventional one-sided market is essentially a matter of labeling. We show that many of the claims about two-sided markets, such as the claim that interchange fees maximize output, are in fact exactly the same as the features of one-sided markets with promotion. The reasoning used in *Amex* to exonerate Amex's use of a no-steering rule and to justify a departure from the usual litigation procedure for evaluation of vertical restrictions in one-sided markets lacks economic foundation. Creating different legal rules for the same economic conduct depending on whether the market can be described as one-sided or two-sided is a mistake that could lead to widespread confusion in the evaluation of vertical restrictions.

[51] A simple ceiling on downstream retailer prices is recognized in both economics and the law as an efficient vertical restraint. It resolves the problem of double-marginalization, keeping prices low, to the benefit of consumers (State Oil Co. v. Khan, 522 U.S. 3 (1997)). But as soon as the ceiling is conditioned upon the price set by competing suppliers, the restraint enters the realm of *contracts that reference rivals* (Scott Morton 2013) and the conclusion as to the competitive impact is reversed.

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APPENDIX A: PROOFS OF PROPOSITIONS

This appendix contains 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

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

$\{0, 0\}$ **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:

$$R_1^{00}(w_2) = \frac{1}{2} + \frac{d}{2}w_2 \tag{13}$$
$$pR_2^{00}(w_1) = \frac{1}{2} + \frac{d}{2}w_1 \tag{14}$$

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

$$\pi_{00}^* = 1/(2-d)^2 \tag{15}$$

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

$$\pi_1(w_1, w_2) = q_1(p, p)w_1 = [1 - (1-d)\frac{(w_1 + w_2)}{2}](w_1 - c) \tag{16}$$

Solving the first-order conditions for the reaction functions yields

$$R_1^{11}(w_2) = \frac{1}{(1-d)} - \frac{w_2}{2} \tag{17}$$
$$R_2^{11}(w_1) = \frac{1}{(1-d)} - \frac{w_1}{2} \tag{18}$$

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

$$p_{11}^* = w_{11}^* = \frac{2}{3(1-d)} \tag{19}$$

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

$$\pi_{11}^* = \frac{2}{9(1-d)} \tag{20}$$

The impact on profits is negative if

$$\pi_{11}^* < \pi_{00}^* \Leftrightarrow \frac{2}{9(1-d)} < \frac{1}{(2-d)^2} \Leftrightarrow d(2d+1) < 1 \tag{21}$$

Proposition 8: Suppose that in the monopoly - competitive fringe model demands are identical for the two products and independent, Any optimal use of the MFN restraint that results in a pure strategy equilibrium 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: With independent and symmetric demands, we denote the demand function facing retailer 1 for either good as $\tilde{q}_1(p_1, p_2)$. Following unilateral deviation by retailer 2 from {accept, accept} at the contract, the retail pricing subgame involves retailer 1 setting price $p_1'$for both goods and earning retail monopoly profits on good 1;denote by p_2' the price of retailer 2 in this game. The Nash equilibrium (p_1^*, p_2^*) for this game, given w,satisfies

$$p_1^*(w) = \arg\max_{p_1}(p_1 - w)q_1(p_1, \infty) + (p_1 - c)q_1(p_1, p_2^*) \tag{22}$$

$$p_2^*(w) = \arg\max(p_2 - c)q_2(p_1^*, p_2) \tag{23}$$

It is straightforward to show that this Nash equilibrium exists, is unique, and that $p_1^*(w)$ is strictly increasing in w. (We omit this proof.)

The monopolist's problem is

$$\max_{w,F,p} 2(w-c)q_1(p,) + 2F \tag{24}$$

subject to

$$p = \arg\max_{\hat{p}} (\hat{p} - w)q_1(\hat{p}, p) + (\hat{p} - c)q(\hat{p}, p) \tag{25}$$

and

$$(p - w)q_1(p, p) + (p - c)q_1(p, p) - F \geq (p_2^*(w) - c)q_2(p_1^*(w), p_2^*(w)) \tag{26}$$

The first of these constraints represents the incentive compatibility condition that p be elicited as an equilibrium price by w.Denote the solution in p to this equation as $\rho(w)$. The second constraint is the individual rationality constraint that retailer 2 (or 1) make at least as much under the contract as by deviating unilaterally to the position of supplying only the competitive good, competing against the other retailer in the subgame following unilateral deviation from {accept, accept}. Denote the right hand side of this constraint, which is the profit from unilateral deviation, by $\pi_{dev}(w)$ Since $\partial p_1^*(w)/\partial w > 0$ and $\partial q_2/\partial p_1 > 0$, we have $\partial \pi_{dev}(w)/\partial w > 0$. Substituting the constraints and definition of $\Pi(p)$ into the objective function, we can rewrite the manufacturer's problem as maximizing industry profits net of the profits to each retailer from deviating:

$$\max_{w} \tilde{\Pi}(w) \equiv \Pi(p_1^*(w)) - 2\pi_{dev}(w) \tag{27}$$

At the w that elicits p^*,the price that maximizes Π,we have $\partial\tilde{\Pi}/\partial w = -2\partial\pi_{dev}(w)/\partial w < 0$. This shows that it is optimal to set w at value lower than the level that would elicit p^*.

Proposition 14: *Under the perfect cash-back assumption, if* $G = (f_1, f_2, a, (x_1, ..., x_n), p, s)$ *is an equilibrium then the following set of strategies is an equilibrium with equal payoffs:* $\hat{G} = (f_1, f_2, a + \Delta, (x_1 + \mathit{\Delta}, ..., x_n), p, s + \Delta)$.

proof: We apply the following property of any game:

Lemma: Consider any game G consisting of n players; strategy sets $S_1, \ldots S_n$ with $S = S_1 \times S_2 \times \ldots \times S_n$; and payoff functions $\pi_1(S), \ldots, \pi_n(S)$. Let T be an operator on $S, T : S \rightarrow S$. Suppose that (1) T preserves payoffs: $\forall i, \forall s \in S, \pi_i(T(s)) = \pi_i(s)$; and (2) $\forall i \forall s_{-i}, T(s_i, s_{-i})$ i is 1-to-1 and onto S_i .Then if $s*$ is a Nash equilibrium for G , $T(s*)$ is also a Nash equilibrium for G . If if $s*$ is a subgame perfect Nash equilibrium for G, $T(s*)$ is also a subgame perfect Nash equilibrium for G.

Proof of lemma: $s*$ is a Nash equilibrium implies that $\forall i, \forall s_i\prime \in S, \pi_i(s_i*; s_{-i}*) \geq \pi_i(s_i\prime; s_{-i}*)$. From the property that T preserves payoffs, and letting $T_i(s)$ be the ith element of $T(s)$, we have

$$\forall i, \forall s_{i\prime}, \pi_i(T_i(s*); T_{-i}(s*)) \geq \pi_i(T_i(s_{i\prime}; s_{-i}*); T_{-i}(s*)) \tag{28}$$

From the 1-to-1 and onto property, we can substitute $s_{-i'}$ for $T_{-i}(s*)$ on the right hand side of (28). In other words, $T_i(s*)$ satisfies the Nash condition. This proves the first part of the lemma. Since a subgame is a game, this holds for every subgame of G as well, proving that subgame Nash equilibria are also preserved.

To apply the lemma in the proof of the proposition, consider the transformation $T(f_1, f_2, a, x, p, s) = (f_1, f, a + \Delta, (x_1 + \Delta, ...x_n), p + \Delta, s)$. It is straightforward to verify that the payoffs for all three agents are preserved by T . That is, starting from any set of strategies (f_1, f_2, a, x, p, s) (not just equilibrium strategies), if the issuer reacts to an increase in a of an amount Δ by raising cash back by Δ , while the merchant reacts to the increase in its fee by Δ (that is passed along by the competitive acquirer) then demand is unchanged and all parties ' payoffs are unchanged. The lemma implies that subgame perfect Nash equilibrium is preserved by the transformation.

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

$$\frac{\eta_A}{\eta_p} = \frac{\varepsilon_2}{\varepsilon_1} \tag{29}$$

or

$$\frac{\partial Q/\partial A}{\partial Q/\partial p_1} \cdot \frac{A}{p_1} = \frac{\partial q/\partial p_2}{\partial q/\partial p_1} \cdot \frac{p_2}{p_1} \tag{30}$$

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

$$\frac{\partial Q/\partial A}{\partial Q/\partial p_1} = \frac{\partial q/\partial p_2}{\partial q/\partial p_1} \cdot \frac{1}{q} \tag{31}$$

In short, to prove the proposition we must show (31). 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

$$\frac{\partial Q(p_1, A)/\partial A}{\partial Q(p_1, A)/\partial p_1} = \frac{-[\partial F/\partial A]/[\partial F/\partial Q]}{-[\partial F/\partial p_1]/[\partial F/\partial Q]} = \frac{\partial F/\partial A}{\partial F/\partial p_1} = \frac{\partial q/\partial p_2 \cdot (1/q)}{\partial q/\partial p_1} \tag{32}$$

which is identical to (31).

ON-LINE APPENDIX (not for publication)

The profitability of the vertical MFN for a monopolist facing a (differentiated) competitive fringe upstream and duopolist retailers downstream

We have, for the case of monopoly - differentiated fringe upstream and duopoly retailers downstream, characterized the optimal MFN *if* the vertical MFN restraint is adopted, when retailers have the option not to carry the manufacturer's product. This specification is described in row 4 of Table 1. The monopolist is constrained by retailers' participation constraints to set terms of the vMFN contract (the wholesale price w in particular) at values that will elicit less than the full industry profits. 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 share of profits that must be left with retailers so large that the remaining profits are less than the monopoly profits without the MFN?

The question is too complex for analytics, in part because of mixed strategy equilibria in some subgames. Instead, we undertake numerical simulation of the duopoly retailer model. We find that the restraint is profitable for some but not all parameter values. The results as to where the MFN restraint is profitable are intuitive.

To set out a parameterized example, we assume that distinct groups of consumers demand each product. The downstream 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, as functions of prices (including transportation costs) are[52]

$$q_1 = 1 - p_1 \tag{33}$$

$$q_2 = a - p_2 \tag{34}$$

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). We omit the algebra of the solution to the model (which accommodates mixed strategies for some parameters) and simply present, in Figure A1, the sets of parameters (a, t) for which MFN is and is not profitable.

[52] The following is a completely general parameterization of independent linear demands, given the freedom to choose units of quantities and currency.

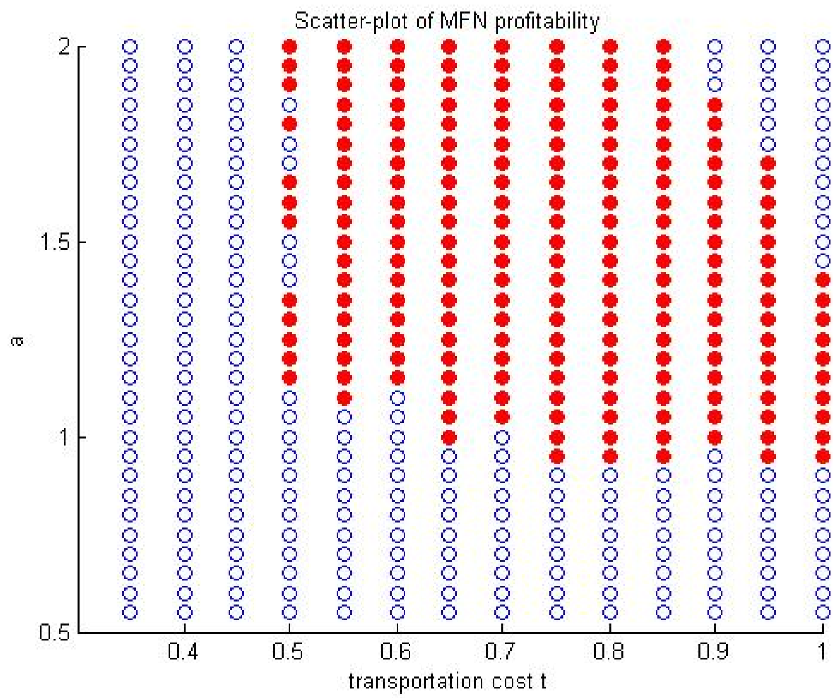

Figure A1: Parameter Values (a,t) for which the vMFN is profitable under the linear demand

The numerical results conform with the theory in the sense that when a and t are very high or t is very low then MFN cannot be profitable. When a and t are high, then the retailers are close to local monopolists, so there is little benefit to total supply chain profits from using MFN to raise the competitive good price. But there are costs: imposing on the supply chain a single price for both goods will reduce total supply chain profits, since the profit-maximizing price for the competitively supplied good is higher. When t is very low, the profit available to a retailer from deviating from {Accept, Accept}, i.e. from pricing the competitive good slightly below the price that the other retailer would set for both goods, is high because the deviating retailer can capture a greater share of the entire set of retail customers. This high profit from deviating forces the manufacturer to share a large portion of the profits under MFN with each retailer to meet the retailer's participation constraint, and this makes MFN less profitable. Between the two regions in which we know a priori that MFN is unprofitable, Figure A1 illustrates a swath in the parameter space over which MFN generates an increase in profits. The example confirms, in other words, that MFN can be profitable in this setting.