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## Competition before sunset: The case of the Finnish ATM market

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Maria Kopsakangas-Savolainen – Tuomas Takalo

# Competition before sunset: The case of the Finnish ATM market



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# Competition Before Sunset:

  

## The Case of the Finnish ATM Market\*

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### Abstract

We build a simple model to study service fee competition between an incumbent and an independent ATM deployer, and its optimal regulation. We use the model to analyze an actual regulation of such a market by competition authorities in Finland. We find that socially optimal first-best fees would imply negative profits for the independent deployer, calling for a Ramsey regulation. While the Finnish regulation pushes the foreign fee downwards towards its socially optimal level, the regulated fees are likely to remain too high from the welfare point of view. In contrast with the actual regulation, it would be essential to regulate the independent deployer's interchange fee, as the incumbent deployer internalizes the effect of its foreign fee on consumer usage of the rival's network and has little incentive for foreclosure.

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# 1 Introduction

The Finnish Automatic Teller Machine (ATM) market was long dominated by a monopoly deployer owned by the major Finnish banks. The use of cash at the daily point-of-sale transactions has been declining relatively fast, and the incumbent deployer was cutting back its ATM network. In 2008, however, an independent ATM deployer (IAD) entered the market and several other IADs were poised to enter. The subsequent competition resulted in a peculiar ATM service fee structure that attracted interest by the Finnish Competition Authority (FCA). In its decision of 2009 the FCA caps the foreign (on-other's) fee charged by the incumbent deployer but leaves other fees unregulated.

In this paper we build a simple model to study service fee competition and its optimal regulation in an ATM market where an incumbent deployer encounters an IAD. We then compare the optimal regulation suggested by our model with the actual regulation implemented by the FCA. While our model is inspired by the Finnish case, our analysis and results ought to be of more general interest: The ATM industry poses challenges for regulators and competition authorities around the world, as neither free competition nor an unregulated monopoly protected from entry is likely to yield socially optimal outcome in ATM markets. The ATM industry is also of inherent interests to Central Banks given their statutory duty to ensure smooth operation of payment systems. For that reason, for example, the Reserve Bank of Australia also acts as the regulator of the Australian ATM market, and in 2009 it implemented a major ATM fee reform that eliminated foreign and interchange fees. More generally, the way cash supply is organized is not trivial: Schmiedel, Kostova and Ruttenberg (2012) estimate that the social costs of providing retail payment services are almost 1% of GDP in Europe, but cash has on average the lowest costs per transaction.

In our model we take some key institutional features of the Finnish ATM market as given and analyze the welfare consequences of competition as it emerged in the market. In particular, we

assume that networks are technologically compatible, the incumbent deployer does not charge an on-us fee for consumer use of its own network, nor does the IAD surcharge. While the model is parsimonious, it yields a number of striking predictions. For example, it predicts that the IAD's equilibrium market share will be around  $1/8$ . The model further suggests that the incumbent deployer internalizes the effects of its foreign fee on consumer usage of the IAD's network. As a result, the incumbent has little incentive to set a high foreign fee to foreclose the IAD. Nonetheless, unregulated competitive fees are unambiguously too high from the welfare point of view, calling for regulated lower fees. It turns out that the socially optimal first best fees would not allow the IAD to balance its budget. We therefore also characterize the optimal Ramsey (second best) regulation.

Our model suggests that the fees stemming from the FCA decision are likely to be higher than both the first and second best fees. In contrast with the FCA's focus on the foreign fee, our model suggests that it would be essential to regulate the interchange fee. To obtain the first best it would suffice to regulate the interchange fee alone. The second best outcome would be reached by regulating both foreign and interchange fees simultaneously. If the direct and opportunity costs of a withdrawal from the incumbent ATMs were roughly zero the second best outcome would be realized by setting both fees equal to the cost of a withdrawal from the IAD's ATMs. If we assume that the interchange fee cannot be regulated, the FCA decision does involve an attractive feature as it makes the cap on the foreign fee contingent on the level of the interchange fee. Thus the reaction of the incumbent deployer should be taken into account when setting the interchange fee. Yet, the FCA decision could imply that the incumbent deployer does not balance its budget.

As ATMs constitute a differentiated product industry with primary characteristics being location of machines, we use a spatial competition framework, which has been extensively used to study ATM service fee competition (see McAndrews 2003 for a survey of the early literature). Our model

is a modified version of the model of Croft and Spencer (2004): we abstract from surcharges, and account fees but allow for vertical differentiation of ATMs and consider optimal regulation of usage fees. Our model is also quite related to Donze and Dubec (2009 and 2011) who, inspired by the Australian regulatory reform, consider the welfare effects of various ATM pricing schemes in a spatial competition framework. They study bank-owned deployers and IADs, accounting for consumers' need for other banking services than ATMs. Our model is simpler than theirs: in our model the incumbent and the IAD are similar save for the vertical differentiation of their machines and the fee used as the strategic variable. They do not however consider the fee structure nor optimal regulation we focus on.

The interchange fee in an ATM industry has received a lot of attention by both regulators and academics (for regulatory interest, see, e.g., the Cruickshank Review, 2000; for academic literature, see, e.g., McAndrews 2003, for a survey, and Donze and Dubec 2006 and 2010, for recent examples). We differ from prior research by focusing on the setting of the interchange fee by an IAD rather than within a shared network.

Two important limitations should be acknowledged at the outset. First, as mentioned above, we abstract from modeling basic banking services and their pricing. The results of Massoud and Berthardt (2002) suggest that banks set high account fees but charge minimal on-us fees. This equilibrium appears to characterize the Finnish banking service market and we take these features as given. Second, we do not consider ATM operators' deployment incentives. Prior research (e.g., Donze and Dubec 2010) suggests that lower service fees might discourage ATM deployment, and optimal regulation should take this effect into account. We hope our work will stimulate future research on the optimal regulation of ATM service fees when ATM deployment is endogenous.

The rest of the paper is organized as follows. In Section 2 we summarize the key characteristics

of the Finnish payment media and ATM market. We develop the model in Section 3, and study the optimal regulation in Section 4. In Section 5 we use the results of Section 3 and 4 to evaluate the decision of the FCA. Conclusions are in Section 6.

## **2 Institutional Environment**

### **2.1 Payment media market**

The Finnish market for payment media is relatively advanced, for Finns have for some time now relied on accessing electronic payment networks at the point-of-sale (see, e.g., Amromin and Chakravorti, 2007, and Leinonen, 2008, for cross-country comparisons, and Hyytinen and Takalo, 2009, for payment habits in Finland). Checks disappeared from daily consumer trade in the 1980s, and debit cards became subsequently popular: In 2007, debit cards (including Visa Electron) accounted for approximately 75% of the value of all card payments.

The Finnish market for payment media is concentrated, because the few main deposit banks that dominate the banking sector are the main issuers of payment media. The pricing of payment media, and the ways of providing them with customers tend to be similar across the issuers, at least after controlling for the banking relationships of consumers. At least one ATM or payment card is often automatically attached to a banking account as a part of a banking service package. The packages can include various payment media, whose pricing hence depends on the pricing of the banking service packages. If a payment card is not a part of the service package, an annual fee is charged. Consumers rarely face transaction fees for using a payment medium, and withdrawing cash from ATMs was free (with the exception of credit card withdrawals) until the entry of the new ATM operator. Also, all banks have kept withdrawing cash from one's own account free.

The use of cash at the daily point-of-sale transactions has been decreasing in Finland: various surveys indicate that the use of cash as the most typical way of paying for daily consumer goods and services decreased by roughly 50% between 1999 and 2008. As a result, most consumers no longer use cash as their most typical payment method (see Hyytinen and Takalo, 2009). A special feature of the Finnish market is that the use of cash is often preceded by the use of an ATM. For example, getting “cash back” when paying with a card (say, at a retail store) was very rare before this decade. Using ATMs is easy, since virtually everyone has a banking account where incomes are credited directly and an ATM (compatible) card. (Naturally those who seek to use the euro value notes that are not available from ATMs cannot use them).

## **2.2 The development of ATM network**

The first ATMs were introduced in 1971. The first network was operated jointly by the banks. ATMs remained a curiosity in the 1970s but their number started to rapidly increase in the 1980s following the introduction of bank cards in 1981. At this stage banking groups operated their own networks, which were not compatible with each others. Because deposit and loan rates were regulated, the banking groups competed by the scope of their service network. The last phase of service competition was the expansion of ATM networks.

ATM networks were remade compatible in 1990 in the aftermath of deregulation of banking sector. The subsequent banking crisis of the early 1990s expanded the coverage of ATM networks, because the banks replaced their branches by ATMs to cut down costs. The major Finnish banks formed a joint venture, Automatia Pankkiautomaatit Plc, to co-operate their ATM networks in 1994. The ATMs in the joint-owned network were labelled as “Otto.”. In the early 2000s Automatia expanded its operations to the supply of currency to bank branches. In 2001, smaller banks that



have remained outside the joint venture became its customers, and since 2004 Automatia has owned and operated all ATMs in Finland. The amount of cash withdrawn from ATMs rose up to the launch of euro notes, peaking at 17.4 billion euros in 2003, and has since then decreased slightly.

Automatia has been cutting back the coverage of the ATM network over its entire existence. There were 1655 ATMs in Finland at the end of September 2012, which is a low number by European standards even in relation to population.

### **2.3 Competition**

Up to 2008 Automatia operated as a monopoly, but in March 2008 Eurocash Finland Plc (a subsidiary of Kontanten Plc, a large independent Swedish ATM deployer) entered the Finnish ATM market by introducing its own ATMs (labelled as "Nosto") associated with R-kiosk outlets (which are roughly similar to 7-Eleven outlets). The plan was to introduce more than 500 new machines. At the same time two other IADs announced their plans to enter to the Finnish ATM market. In particular, Suomen Käteisnosto Plc, owned by high-profile Finnish businessmen, announced a launch of an independent ATM network in co-operation with First Data Corporation, a major player in retail payment infrastructure and data processing market in the US. However, the plans of the other entrants have failed to materialize so far. Similarly, Eurocash has failed to expand its network according to its initial plans - there were only 42 Nosto-ATMs in Finland at the end of September 2012.

That competition has remained more limited than what was thought at the time of entry might be due to fees on the use of entrant's ATMs levied by the banks using Automatia's services and issuing payment cards. These fees consisted of a fixed amount of one euro per transaction plus a variable amount ranging from 0.75% to 2% (depending on the bank) of the value withdrawal. The

introduction of these foreign fees prompted Suomen Käteisnosto to file a complaint to the FCA. We study the FCA's decision in the matter in more detail in Section 5. In what follows we focus on service fee competition between the incumbent, Automatia, and the sole entrant, Eurocash.<sup>1</sup>

Eurocash's stated rationale for the entry is that there are too few ATMs in Finland, and it aims at giving the consumers easy and secure access to cash and to be present in high traffic locations in Finland. The R-kiosk chain, with which Eurocash closely cooperates, calculates that having an ATM in a store will increase sales.

There are differences between the business models of Automatia and Eurocash. As the incumbent Otto.-network is owned by the major banks that also issue other payment media besides cash, the incumbent's goal is not necessarily to maximize the profits from the use of its own machines. In contrast, Eurocash is an IAD supplying only cash to consumers and is not involved in issuing other payment media. This difference in business models shows up in the incumbent's and IAD's strategies to price the ATM use.

From consumer point of view, the pricing strategies are relatively simple but, in the case of the IAD's Nosto-machines, not necessarily transparent.<sup>2</sup> Contracts between banks and Automatia do not restrict the banks' service fee setting. However, no bank charges their cardholders for the use of Otto.-ATMs, i.e., the on-us fee is zero.<sup>3</sup> But, as mentioned, the banks charge their customers for using Eurocash's Nosto-ATM network, i.e., there is a positive foreign fee. Since the IAD is not issuing cards, it does not have members of its own. The IAD is not charging customers for the use

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<sup>1</sup>To understand this competition, we have not only resorted to the material available from public sources but also interviewed private sector industry practitioners and industry experts at the Bank of Finland and the FCA.

<sup>2</sup>The Finnish Consumer Agency (2011) urged card issuing banks and Eurocash to increase transparency of fees charged for the use of Nosto-machines.

<sup>3</sup>Automatia charges a fixed membership fee and a transaction-based (interchange) fee from banks. Furthermore, there is an additional fee for a local bank (branch) if a traffic level of an ATM it operates is less than half of the average ATM traffic (roughly 8000 withdrawals per month) . Automatia's profits, if any, are distributed to banks that have equal ownership shares.

of its Nosto-ATMs, i.e., Eurocash does not surcharge. But the IAD charges an interchange fee, i.e., Eurocash receives payments from banks according to their cardholders' use of Nosto-machines.

Besides business models, ATMs themselves are rather different between the rival networks. They have different colors and user interfaces. Thanks to a different user interface and rapidly increasing number of fraud cases associated with the use of the incumbent's Otto.-machines, the IAD's Nosto-machines may be perceived to be more secure to use by consumers. Because of these security concerns, Automatia has been upgrading its Otto.-machines from the beginning of 2012. Moreover, the incumbent's machines distribute only EUR 20 and EUR 50 notes whereas IAD's machines also allow for withdrawals of EUR 10 notes.

### 3 A Model of Differentiated ATM Network Competition

In this section we build a model of service fee competition between two differentiated ATM networks that employ different pricing strategies and ATMs, taking the institutional features of the Finnish ATM market as given (see the previous section). Consider two networks indexed  $i = O, N$  that compete for a unit mass of consumers that are uniformly distributed on a Hotelling line. The networks are technologically compatible but network  $O$  is operated by card issuing banks while network  $N$  is an IAD. In other words, network  $O$  is the sole issuer of ATM cards.<sup>4</sup> Following the market practice in Finland, we assume that network  $O$  does not charge an on-us fee nor does network  $N$  surcharge. As a result, the sole pricing variable used by network  $O$  is a foreign fee, i.e., the price network  $O$  charges for the use of ATMs of network  $N$ . Similarly, network  $N$  can only obtain revenues by receiving interchange fee payments from network  $O$  for the use of its ATM

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<sup>4</sup>For brevity, we do not distinguish between a network and card issuing banks operating the network unless otherwise indicated.

machines. Note that because network  $O$  issues all cards, surcharges by network  $O$  and on-us and foreign fees by network  $N$  are immaterial. We also abstract from banks' account fees, and wholesale fees levied by network  $O$  on card issuing banks.<sup>5</sup>

For simplicity, it is assumed that each consumer makes just one withdrawal and hence the number of consumers is a proxy for the number of transactions. The utility of a typical consumer who obtains cash from an ATM operated by network  $i$ ,  $i \in \{O, N\}$ , is

$$u_i = M_i - tx_i \tag{1}$$

where  $M_i$  denotes the incremental utility received by each consumer from using an ATM of network  $i$ ,  $t$  is the unit travelling cost (disutility of not getting cash immediately) and  $x_i$  is the distance from a consumer's location to the nearest ATM of network  $i$ . As shown by (1), we allow the networks' ATMs be vertically differentiated: A consumer may receive a different incremental utility depending on the network from which the consumer withdraws cash.

It is assumed that  $M_i$ ,  $i \in \{O, N\}$ , is sufficiently large so that in equilibrium market is fully covered. Thus the marginal consumer is indifferent between the two networks. Such indifference requires that

$$M_O - tx_O = M_N - f - tx_N, \tag{2}$$

where  $f$  is a foreign fee charged by network  $O$  for the use of network  $N$ 's ATMs. Since consumers

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<sup>5</sup>In the Finnish case the interchange fee set by Automatia (equivalent to network  $O$ ) - which also owns the network's ATMs - has a slightly different meaning than what is the typical case considered in the literature where a cardholder's bank pays the interchange fee to a bank owning the ATM. See also footnote 3. Unless otherwise indicated, the interchange fee refers to the IAD's interchange fee in our paper.

are uniformly distributed on the line, we have  $x_O = 1 - x_N$ . Therefore (2) can be rewritten as

$$X_O(f) = \frac{1}{2} + \frac{f - \Delta M}{2t}, \quad (3)$$

where  $\Delta M \equiv M_N - M_O$  captures the difference between the service quality of network  $N$ 's and  $O$ 's ATMs. Note that the quality difference can be either positive or negative. We postpone the discussion of an empirically plausible sign of  $\Delta M$  to the end of this section. Equation (3) gives the demand function of network  $O$ 's ATM services. Analogously, the demand function of network  $N$ 's services is given by

$$X_N(f) = 1 - X_O(f) = \frac{1}{2} - \frac{(f - \Delta M)}{2t}. \quad (4)$$

Let  $c_i$  denote the cost an ATM withdrawal causes to network  $i \in \{O, N\}$  and let  $a$  denote the interchange (access) fee paid by network  $O$  to network  $N$ . The profit function of network  $O$  can then be written as

$$\pi_O(f, a) = -c_O X_O(f) + X_N(f)(f - a). \quad (5)$$

In the right-hand side of (5), the second term comes from the net profits derived from cash withdrawals of network  $O$ 's cardholders from the rival's network. The first term captures the net costs caused to network  $O$  by withdrawals from its own ATM machines. Note that  $c_O$  is not necessarily positive. While withdrawals create direct costs to network  $O$  (associated with, e.g., supply of cash and maintenance of machines), providing ATM services involves complex opportunity costs for the banks operating network  $O$  whose net effect is hard to evaluate. For example, ATM services may generate cost savings if their customers use ATMs rather than withdraw their cash from banks' service desks. But greater availability of ATM services may also reduce the bank's revenues from payment card usage if this dilutes customers' incentive to use cards. Since studying the substitution

effects from the use of ATMs in a model that incorporates banks' full service portfolio is beyond the scope of this study (see Verdier 2012 for an analysis of these substitution effects), we take that  $c_O$  is a proxy for the sum of direct cost of a withdrawal and its opportunity cost for providing ATM services.

The profit function of network  $N$  is given by

$$\pi_N(f, a) = X_N(f)(a - c_N), \quad (6)$$

which shows how network  $N$  obtains revenues from interchange fees and encounters costs from withdrawals of its ATM machines. In our case it is reasonable to assume that  $c_N > 0$ , since the use of network  $N$ 's machines only involves direct costs to the network.

Following the literature (e.g. Laffont, Rey, and Tirole 1998, Croft and Spencer 2004, and Donze and Dubec 2006) we consider a two-stage game where an interchange fee is set first and then usage fees are chosen. From a practical point of view, such timing could be motivated, e.g., by international Visa and MasterCard fall-back rules that are more difficult to change than networks' usage charges. We look for subgame perfect equilibria, solving the game backwards.

In stage two, network  $O$  chooses foreign fee  $f$  to maximize (5), taking the interchange fee as given. The first-order condition<sup>6</sup> is given by

$$\frac{\partial \pi_O}{\partial f} = -\frac{\partial X_O}{\partial f} c_O - \frac{\partial X_O}{\partial f} (f - a) + 1 - X_O = 0. \quad (7)$$

Since  $\partial X_O / \partial f > 0$ , an increase in the foreign fee increases (decreases) the demand for network  $O$ 's ( $N$ 's) services, as some consumers shift from network  $N$  to network  $O$ . The first term in (7)

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<sup>6</sup>Second-order conditions hold for all maximization problems in this paper.

captures the costs caused to network  $O$  by increased use of its machines (these may be positive or negative as discussed above). The second term shows how the shrinkage of network  $N$ 's demand is costly from network  $O$ 's point of view, as the use of network  $N$ 's ATMs generates profits to network  $O$ . The last term depicts marginal revenues from a higher foreign fee.

Using (3) to solve (7) for  $f$  gives

$$f(a) = \frac{a + t + \Delta M - c_O}{2}. \quad (8)$$

This reaction function of network  $O$  is increasing in the interchange fee. It is also increasing in the service quality difference but decreasing in own costs: If the use of network  $O$ 's machines becomes costlier, network  $O$  lowers the foreign fee to encourage the use of network  $N$ 's machines. Similarly, if  $\Delta M$  increases, consumers are more inclined to use network  $N$ 's ATMs, and network  $O$  can raise the foreign fee. As usually, network  $O$ 's reaction function is increasing in the unit travelling cost.

In stage one, network  $N$  chooses interchange fee  $a$  so as to maximize (6) taking into account (8). The first-order condition reads as

$$\frac{d\pi_N}{da} = \frac{\partial X_N}{\partial f} \frac{a - c_N}{2} + X_N = 0. \quad (9)$$

In (9), the first term comes from  $\partial\pi_N/\partial f * (df/da)$  and shows how an increase in the interchange fee prompts network  $O$  to raise its foreign fee due to strategic complementarity of the fees, which decreases the demand for network  $N$ 's ATMs (as  $\partial X_N/\partial f < 0$  by (4)). The second term captures

the marginal revenues of the increased interchange fee. Using (4) and (8) to solve (9) for  $a$  gives

$$a = a^c \equiv \frac{t + \Delta M + c_O + c_N}{2}. \quad (10)$$

Substituting (10) for (8) yields

$$f = f^c \equiv \frac{3(t + \Delta M) + \Delta c}{4}, \quad (11)$$

where  $\Delta c \equiv c_N - c_O$  depicts cost difference between network  $N$ 's and  $O$ 's machines. Like service quality difference  $\Delta M$ , the cost difference can be either positive or negative.<sup>7</sup> We postpone the discussion of the sign of cost difference to the end of the section.

Equation (10) shows, in line with a standard Hotelling's model, that equilibrium interchange fee  $a^c$  increases if the relative service quality of network  $N$  improves or costs of ATM withdrawals irrespective of the network increase. While equilibrium foreign fee  $f^c$  is also increasing in the rival's costs, it is *decreasing* in the own costs and in the relative service quality of network  $O$  (see (11)). However, this is intuitive upon recalling that network  $O$  wishes to encourage the use of rival network (at least for  $c_O \geq 0$ ). As usually, both unregulated equilibrium ATM prices are increasing in travelling costs.

Substituting (11) for (3) and (4) yields the equilibrium market shares of the two networks:

$$X_O = \frac{7}{8} - \frac{(\Delta M - \Delta c)}{8t} \quad (12)$$

and

$$X_N = \frac{1}{8} + \frac{\Delta M - \Delta c}{8t}. \quad (13)$$

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<sup>7</sup>Donze and Dubec (2011) also allow for a cost difference between banks' and IADs' ATMs but they assume IADs' machines are more cost efficient.



As is intuitive, network  $O$ 's equilibrium market share is decreasing in the service quality difference and increasing in the cost difference. The reverse applies for network  $N$ 's market share. Note that the network  $N$ 's market share is non-negative only if

$$t + \Delta M - \Delta c \geq 0. \quad (14)$$

From (10) we also see that if (14) holds,  $a^c \geq c_N$ , implying non-negative profits for network  $N$ 's (see (6)). In what follows we assume that (14) holds.

By substituting equilibrium fees (10) and (11), and equilibrium market shares (12) and (13) for the profit functions of the networks (5) and (6), equilibrium profits can be written as

$$\pi_N = \frac{(t + \Delta M - \Delta c)^2}{16t} \quad (15)$$

and

$$\pi_O = \frac{(t + \Delta M - \Delta c)^2}{32t} - c_O = \frac{\pi_N}{2} - c_O. \quad (16)$$

In words, the profit of network  $N$  is decreasing in the cost difference and increasing in the service quality difference as one could expect. Perhaps surprisingly the profits of network  $O$  is also increasing in the service quality difference and decreasing in the cost of withdrawing from network  $N$ 's machines. But again, the result is explained by the fact that the network  $O$  derives revenues from the use of network  $N$ 's ATMs. Also, under (14) the profits of the network  $O$  are decreasing in its own cost. Besides assuming (14), guaranteeing that  $\pi_N \geq 0$ , we also assume that  $\pi_O \geq 0$ , i.e., that

$$(t + \Delta M - \Delta c)^2 - 32tc_O \geq 0 \quad (17)$$

holds. Note that (17) imposes a more stringent restriction on parameters than (14) for  $c_O > 0$ , whereas (14) binds for  $c_O \leq 0$ .

As (12)-(16) show, equilibrium market shares and profits crucially depend on the differences in service qualities and costs implied by ATM withdrawals. Based on Section 2, it is plausible to think that in the institutional environment of our interest,  $\Delta M \geq 0$ , because network  $N$ 's machines carry a larger variety of notes and might be perceived more secure. Similarly, there are several reasons to think that  $\Delta c \geq 0$ . First, maintaining a larger note variety involves larger direct costs of withdrawals. Second, there are economies of scale in operating an ATM network which implies that network  $O$  should have lower direct costs per ATM withdrawal. Finally, as argued above, network  $O$  needs to take into account the opportunity costs of providing ATM services, which may be positive or negative. In case they are negative,  $c_O$  could even be negative. While we will continue to allow  $c_O < 0$ , it is nonetheless plausible to think that  $c_N > c_O \geq 0$ .

Assuming that the opportunity costs of providing ATM services are approximately zero,  $\Delta M - \Delta c$  can be thought of capturing relative efficiency of network  $N$ 's and  $O$ 's ATMs. As a result, (12) and (13) show that if the networks' ATMs are approximately equally efficient in the sense that service quality and cost differences cancel out each other (or if the differences are roughly zero), network  $O$  captures approximately 7/8 of the market in equilibrium and network  $N$  is left with 1/8 of the market. (The market share of network  $N$  is higher (lower) than this benchmark if its ATMs are more (less) efficient than the ATMs of network  $O$ ). The asymmetry in the market shares arises from different pricing strategies. Network  $N$  has an incentive to set a high interchange fee, since this will not affect consumers' choices directly. However, a high interchange fee prompts network  $O$  to raise its foreign fee due to strategic complementarity. This discourages the use of network  $N$ 's and generates a larger markets share for network  $O$ .

Even if network  $O$  is enjoying a high market share its profits may be (much) smaller than the profits of network  $N$ . As shown by (15) and (16), a sufficient condition for this is that the net costs of ATM withdrawals borne by network  $O$  are positive ( $c_O \geq 0$ ). In that case, network  $O$ 's smaller profits are unsurprising given that it is charging no on-us fee and is then making losses from cash withdrawals from its own machines.

## 4 Welfare and Regulation

Social welfare generated by the ATM duopoly is given by

$$W = M_O \int_0^{X_O} dx + M_N \int_{X_O}^1 dx - \int_0^{X_O} (c_O + tx)dx - \int_{X_O}^1 (c_N + (1-x)t)dx. \quad (18)$$

The first and second term on the right-hand side of (18) depict the consumers' gross utility from cash withdrawals from network  $O$ 's and  $N$ 's ATMs, respectively, and the third and fourth term capture the costs associated with ATM use (consumers' travelling costs to the nearest ATM and the costs of withdrawals incurred by networks  $O$  and  $N$ ). As (18) shows, welfare does not directly depend on the fees, since they merely represent transfers between consumers and networks. Welfare, however, indirectly depends on the fees as they affect how the market is shared between the networks, i.e., the fees affect  $X_O$  (recall that  $X_O$  is increasing in  $f$  which in turn is increasing in  $a$  in equilibrium).

To derive a socially optimal foreign fee, we maximize (18) with respect to  $f$ . Using Leibnitz's rule this yields

$$\frac{dW}{df} = \frac{dX_O}{df} [t(1 - 2X_O) - \Delta M + \Delta c] = 0. \quad (19)$$

Solving (19) for  $f$  gives

$$f = f^* \equiv \Delta c. \quad (20)$$

The socially optimal foreign fee  $f^*$  should be positive only if the marginal cost difference is positive, i.e., only if network  $O$ 's machines are more cost efficient than network  $N$ 's machines or if the network  $O$ 's opportunity costs for providing ATM services are low or negative. In such situations the increase in the use of network  $O$ 's machines decreases the total cost of ATM use, and it may be socially optimal to increase  $f$  to promote the use of network  $O$ 's machines at the expense of network  $N$ 's machines.

If  $f$  is fixed at an arbitrary level, the question of an optimal interchange fee is moot as  $a$  affects welfare only via  $f$ . Hence seeking the optimal interchange fee makes sense only if we let  $f$  to be determined by  $f(a)$  as given by (8). Setting  $f(a)$  equal to  $f^*$  and solving for  $a$  yields

$$a = a^* \equiv c_N - t - \Delta M + \Delta c. \quad (21)$$

The expression for the socially optimal interchange fee  $a^*$  is somewhat more complicated but makes sense. As an interchange fee discourages the use of network  $N$  due to the strategic complementarity of the fees, the interchange fee should be increased if service quality or cost efficiency of network  $O$  improves with respect to network  $N$ . If the service quality and cost differences roughly cancel out each other (as might be the case in our institutional environment), the optimal interchange fee is simply given by the difference between the cost of a withdrawal from the network  $N$ 's machine and the unit travelling cost.

Comparing unregulated fees  $a^c$  and  $f^c$  from (10) and (11) to the socially optimal fees  $a^*$  and  $f^*$  as given by (21) and (20), respectively, shows that under (14) the unregulated fees are too high from the welfare point of view. This is not surprising given that the networks have local market power, are vertically differentiated, and use asymmetric pricing strategies. We summarize the above results in the following proposition.

**Proposition 1** *The socially optimal foreign and interchange fees are given by  $f^* = \Delta c$  and  $a^* = c_N - t - \Delta M + \Delta c$ , respectively. It holds that  $a^c \geq a^*$  and  $f^c \geq f^*$ .*

Let us now consider the regulation of the fees. In principle, the policy maker could regulate either foreign fee or interchange fee or both. While the rule for the optimal foreign fee ((20)) is appealingly simple, the model suggests that there is little rationale to regulate the foreign fee alone without regulating the interchange fee simultaneously. To see this, note that if the foreign fee is regulated at some fixed and finite level but network  $N$  is allowed choose the interchange fee freely, the interchange fee will be “as high as possible”: when choosing the interchange fee network  $N$  does no longer need to take into account the response by network  $O$ . As a result, the interchange fee could be so high that network  $O$  would be driven out of the market.

Regulating both fees yields socially optimal outcome if the fees are set to  $a^*$  and  $f^*$ . However, the model suggests that everything that can be achieved by regulating foreign and interchange fee jointly can also be achieved by regulating interchange fee only: if the interchange fee is set to the optimal level  $a^*$ , network  $O$  would choose the optimal foreign fee  $f^*$  automatically. But there is a problem with the regulation of the interchange fee, too: With the welfare-maximizing interchange fee  $a^*$ , network  $N$  does not balance its budget since (14) implies that  $a^* < c_N$ .

We next maximize social welfare with the constraint that both networks at minimum balance their budgets. This Ramsey problem is to choose  $a$  and  $f$  so as to maximize (18) subject to  $\pi_O(f, a) \geq 0$  and  $\pi_N(f, a) \geq 0$ . After substituting (3) and (4) for (5), and observing (6), the non-negativity constraints  $\pi_O(f, a) \geq 0$  and  $\pi_N(f, a) \geq 0$  can be rewritten as

$$-c_O \left( \frac{1}{2} + \frac{f - \Delta M}{2t} \right) + \left( \frac{1}{2} - \frac{(f - \Delta M)}{2t} \right) (f - a) \geq 0 \quad (22)$$

and

$$a \geq c_N. \tag{23}$$

Solving the Ramsey problem where  $a$  and  $f$  are chosen to maximize (18) subject to (22) and (23) yields the following result:

**Proposition 2** *i) If  $c_0 \leq 0$ , the Ramsey pricing allows for the first-best foreign fee  $f^* = \Delta c$ . The second-best interchange fee satisfies  $a^{**} \in [c_N, c_N - 2c_0t/(t + \Delta M - \Delta c)]$  with  $a^{**} \geq c_N \geq a^*$ . ii) if  $c_0 > 0$ , the Ramsey prices are given by  $a^{**} = c_N$  and  $f^{**} = \frac{1}{2} \left[ t + \Delta M + \Delta c - \sqrt{(t + \Delta M - \Delta c)^2 - 8tc_0} \right]$ .*

**Proof.** i) Assume first that (22) does not bind. Then the first-best foreign fee (20) is optimal. Substituting  $\Delta c$  for  $f$  in (22) yields after straightforward algebra

$$a \leq c_N - \frac{2c_0t}{t + \Delta M - \Delta c}. \tag{24}$$

Note first that (14) implies that  $c_N - 2c_0t/(t + \Delta M - \Delta c) \geq c_N$  only if  $c_0 \leq 0$ . Then, from (23) and (24) it is evident that any  $a^{**} \in [c_N, c_N - 2c_0t/(t + \Delta M - \Delta c)]$  satisfies both (22) and (23) with  $f^* = \Delta c$ . Since, for a given  $f$ ,  $a$  constitutes just a transfer between networks without affecting the demand, choosing any  $a^{**} \in [c_N, c_N - 2c_0t/(t + \Delta M - \Delta c)]$  yields the same welfare. Clearly, under  $c_0 \leq 0$  and (14),  $a^{**} \geq c_N \geq a^*$ .

If  $c_0 > 0$ , then (23) and (24) imply that there exists no  $a$  that would simultaneously satisfy (22) and (23) with  $f^* = \Delta c$ . Hence the identified Ramsey pricing solution  $f^* = \Delta c$ ,  $a^{**} \in [c_N, c_N - 2c_0t/(t + \Delta M - \Delta c)]$  applies only if  $c_0 \leq 0$ .

ii) If  $c_0 > 0$ , part i) implies that (22) must bind at an optimal solution. Hence we get that the

second-best foreign fee must satisfy

$$f^{**}(a) = \frac{1}{2} \left[ a + t - c_O + \Delta M \pm \sqrt{(a + t - c_O + \Delta M)^2 - 4(a(t + \Delta M) + c_O(t - \Delta M))} \right],$$

which can be rewritten by means of (8) as

$$f^{**}(a) = f(a) \pm \sqrt{f(a)^2 - a(t + \Delta M) - c_O(t - \Delta M)}.$$

We proceed under the assumption that the term in the square root is non-negative and verify later that this is indeed the case. It is straightforward to show that even the lower root of the above equation is larger than  $f^* = \Delta c$  when (23) holds. This together with the concavity of welfare function in  $f$  implies that the lower root yields higher welfare. We have

$$f^{**}(a) = f(a) - \sqrt{f(a)^2 - a(t + \Delta M) - c_O(t - \Delta M)}. \quad (25)$$

Differentiating (25) with respect to  $a$  gives

$$\frac{df^{**}(a)}{da} = \frac{1}{2} \left[ 1 - \frac{(f(a) - t - \Delta M)}{\sqrt{f(a)^2 - a(t + \Delta M) - c_O(t - \Delta M)}} \right].$$

Now  $df^{**}(a)/da > 0$ , if the term in the square-brackets is strictly positive. A sufficient condition for this is that  $f(a) - t - \Delta M \leq 0$  which, after substitution of (8), is equivalent to

$$a - c_O - \Delta M \leq t. \quad (26)$$

Note next that because  $c_0 > 0$ , (22) can hold only if  $f(a) > a$ . By using (8),  $f(a) > a$  is

equivalent to  $t > a + c_O - \Delta M$ . As  $c_0 > 0$ , this implies that (26) holds. Hence we know that  $df^{**}(a)/da > 0$ . Again, since  $f^{**}(a) > f^*$  and since welfare is decreasing in  $f$  for  $f \geq f^*$ , we want to choose as small  $f$  as possible without breaking the constraints. This implies that also (23) holds as an equality. Inserting  $a = c_N$  into (25) yields after some algebra

$$f^{**} = \frac{1}{2} \left[ t + \Delta M + \Delta c - \sqrt{(t + \Delta M - \Delta c)^2 - 8tc_O} \right].$$

Finally, the term in the square root is positive under (17). ■

To gain understanding of implications of Proposition 2, let us consider the special case (which is not implausible in our case) where  $c_O$  is zero. Then Proposition 2 implies that  $f^{**} = f^* = a^{**} = c_N$ . In words, both fees should be set equal to the cost of a withdrawal from network  $N$ 's machines. Such regulation would internalize the cost difference between networks' machines, while keeping the foreign fee as low as possible and allowing both firms to operate in the market.

## 5 Analysis of the FCA's decision

As described in Section 2, the FCA launched an investigation on the competition and pricing structure in the Finnish ATM market in 2008. The FCA's decision in the matter was published on June 18, 2009 (FCA 2009). The decision reveals concerns about the low number of ATMs in Finland, and the lack of competition in the market. The FCA is worried that foreign fees charged by card issuing banks are too high, and might foreclose the entrants from the market, violating Article 102 of the Treaty on the Functioning of the European Union about the abuse of dominant position. According to the FCA's decision the banks operating Automatia (the Otto.-ATM network) should not to price discriminate new deployers. The decision essentially caps the foreign fee to be at most



equal to the difference between the cost of a withdrawal from Automatia's. ATM and a rival's ATM to the banks.<sup>8</sup>

The FCA does not take a stand on other fees at the market. In particular, the decision leaves the interchange fee unregulated because the FCA assumes that it is exogenous to ATM deployers, being decided by international Visa and MasterCard corporations. Nor does FCA attempt to regulate the on-us fee on the use of Otto.-ATMs. It can be zero also in the future.

The FCA states that its regulation should make withdrawing cash from the ATMs of new deployers cheaper to consumers, and this should encourage the entry and expansion of new ATM networks. The resulting conditions should better meet the customer preferences, and expand their possibilities to choose from different ATMs. A greater product differentiation between different networks could also be possible in future. The FCA also notes that as payment cards are becoming more expensive with the introduction of the Single Euro Payment Area, it is important to ensure the availability of cash to maintain it as a relevant option to cards.

To evaluate the FCA decision within our model, we assume that the banks' consumers use of rival machines causes no other costs besides the interchange fee to the banks. The assumption is not essential but simplifies the subsequent analysis.<sup>9</sup> Under this assumption the FCA decision amounts to a requirement that  $f \leq a - c_O$  in terms of our model. The model predicts that the cap on the foreign fee imposed by the FCA binds in equilibrium: The unregulated foreign fee given by (8) is larger than  $a - c_O$  if  $a \leq t + \Delta M + c_O$  which, by using (10), is equivalent to (14). The cap is also likely to bind in practice, given the goal of the FCA to push the fee downwards. Assuming that the

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<sup>8</sup>The FCA estimates that the cost difference is one euro in case a Visa card is used to withdraw cash and 60-65 cents when a MasterCard withdrawal is made. Here the FCA is only taking into account the direct costs of withdrawals from own (Automatia's) ATMs.

<sup>9</sup>In practice, while the interchange fee constitutes a major part of the banks' cost stemming from their consumer use of rival machines, there are some other costs such as routing costs (a switch fee). In Finland this switch fee is paid to a third party and can safely be ignored from our analysis.

cap binds, the FCA decision would mean in the context of our model that the incumbent deployer's revenue per withdrawal is  $-c_0$  irrespective of an ATM network where withdrawals take place. As a result, this pricing implements the FCA's objective of no-discrimination in the sense that it is immaterial for the owners of the incumbent deployer whether consumers use the incumbent's or entrants' ATMs.

The FCA decision would regulate the foreign fee at the socially optimal level if  $a = c_N$ . This would also correspond the optimal Ramsey regulation of both foreign and interchange fee in case  $c_O \leq 0$ . Unfortunately the FCA does not attempt to regulate the interexchange fee, and the resulting fee structure is likely to be suboptimal.

To determine the fee structure resulting from the FCA decision in the context of our model, we calculate the IAD's optimal interchange fee following the steps described in Section 3 but assuming that the incumbent's reaction function is given by  $f(a) = a - c_O$  instead of (8). It turns out that the IAD's optimal interchange fee does not change, i.e., it is still given by (10). Therefore our model suggests that the fee structure implied by the FCA regulation is given by  $a^r = a^c \equiv (t + \Delta M + c_O + c_N)/2$  and  $f^r = a^r - c_0 = (t + \Delta M + \Delta c)/2$ . Comparing these fees with the socially optimal first and second best fees yields the following result:

**Proposition 3** *The foreign fee implied by the FCA decision is higher than the socially optimal first and second best foreign fees, i.e.,  $f^r \geq f^{**} \geq f^*$ . The same applies to the interchange fee  $a^r$  implied by the FCA decision, i.e.,  $a^r \geq a^{**} \geq a^*$ , if  $c_O$  is not too negative.*

**Proof.** Since  $a^{**} \geq a^*$  and  $f^{**} \geq f^*$ , it suffice to compare  $a^r$  and  $f^r$  with  $a^{**}$  and  $f^{**}$  as given by Proposition 2. There are two cases to consider: i) If  $c_O > 0$ ,  $a^{**} = c_N$ , and condition  $a^r > c_N$  becomes equivalent to (14), which holds as a strict inequality because of (17). Condition  $f^r > f^{**}$  is equivalent to  $(t + \Delta M + \Delta c)/2 > \left[ t + \Delta M + \Delta c - \sqrt{(t + \Delta M - \Delta c)^2 - 8tc_O} \right] / 2$ ,

which clearly holds (recall that the term in the square root is positive under (17)); ii) If  $c_O \leq 0$ , condition  $f^r \geq f^{**} = f^* = \Delta c$  becomes equivalent to (14). To characterize the conditions where  $a^r \geq a^{**}$  we compare  $a^r$  with  $c_N - 2c_0t/(t + \Delta M - \Delta c)$ , the upper bound of the range of  $a^{**}$  for  $c_O \leq 0$ . It is quite immediate that the condition  $a^r \geq c_N - 2c_0t/(t + \Delta M - \Delta c)$  is equivalent to  $(t + \Delta M - \Delta c)^2 + 4c_0t \geq 0$ . The left-hand side of this condition is increasing in  $c_0$ , and is non-negative when  $c_0 = 0$  but becomes negative when  $c_0$  is sufficiently negative. ■

Proposition 3 has two important implications. First, if  $c_O > 0$ , the incumbent deployer is making negative profits under the FCA decision (recall that the incumbent deployer's revenue per withdrawal is  $-c_0$  irrespective of an ATM network where withdrawals take place), despite the higher foreign fee than in the Ramsey benchmark. This occurs because the interchange fee rises more than the foreign fee from the Ramsey benchmark ( $a^r - a^{**} > f^r - f^{**}$ ). Second, even if sufficiently large negative values of  $c_O$  were feasible to allow for  $a^r \in [c_N, c_N - 2c_0t/(t + \Delta M - \Delta c)]$ , this would not mean that the second best optimum could be obtained by regulating the foreign fee at  $f^*$  and leaving the interchange fee unregulated. Rather, it would mean that the optimal second best regulation would be feasible by regulating the interchange fee at  $a^c$  and the foreign fee at  $f^*$ .

More generally, our model suggests that it would be essential to regulate the interchange fee, in contrast to the FCA decision. Recall that equation (7) shows that the incumbent deployer internalizes the effects of the foreign fee on the consumer usage of the entrant's network, and as a result, the incumbent has little incentive to foreclose IADs. To obtain the first best it would suffice to regulate the interchange fee alone: by regulating the interchange fee at  $a = a^*$ , the foreign fee would automatically be set at the socially optimal level in market equilibrium. The second best outcome would be reached by regulating both foreign and interchange fees at a level that results in zero profits for both deployers. If the cost of withdrawals from the incumbent ATMs were

roughly zero the second best outcome would be realized by setting both fees equal to the cost of withdrawals from IADs' ATMs. Nonetheless, a useful feature of the FCA decision is that the cap on the foreign fee is made contingent on the level of the interchange fee. Thus the interchange fee cannot be arbitrarily high as the reaction of the incumbent deployer should be taken into account when setting the interchange fee.

## 6 Conclusion

The Finnish ATM market was long dominated by a monopoly owned by the major Finnish card issuing banks. The use of cash at the daily point-of-sale transactions has been declining, and the incumbent deployer was cutting back its ATM network. In 2008, however, an IAD entered in the market and several other independent deployers were poised to enter. The resulting ATM service fee structure led to an investigation by the FCA. In its decision the FCA caps the foreign fee charged by the incumbent deployer but left the other fees unregulated.

In this paper we build a simple model to study the competition and regulation in an ATM market that takes some main characteristics the Finnish institutional environment as given. We find that unregulated duopoly competition yields too high service fees from the welfare point of view. We then characterize the socially optimal first best fees and show that they would not allow an IAD to balance its budget. We then characterize the optimal Ramsey regulation, and compare the optimal fees with the fee structure arising from the FCA regulation. In sum, our model suggests that while the FCA decision goes to a right direction by pushing the foreign fee downwards towards the socially optimal level and by tying the cap on the foreign fee with the level of the interchange fee, it is suboptimal to regulate the foreign fee alone. Therefore the fee structure resulting from the FCA decision is likely to remain too high from the welfare point of view. In contrast with the

FCA decision, our model suggests that it would be essential to regulate the interchange fee, as the incumbent deployer internalizes the effects of its foreign fee on the consumer usage of IADs' network and has little incentive to foreclose IADs. Since the FCA decision caps the foreign fee but leaves the interchange fee unregulated, it could imply that the incumbent network does not balance its budget.

While our analysis is inspired by the insitucional environment of the Finnish ATM market our results should be of interest to regulators and competition authorities in many other jurisdictions as ATMs operated by independent deployers are becoming more common. Much work, though, remains to be done to in order to develop a broader vision of regulation of ATM markets where bank-owned deployers and IADs compete. In particular, future work should consider the effect of regulation on ATM operators' deployment and other investment incentives, building on the advances made by Donze and Dubec (2010).

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