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On the Incentives to Form Strategic Coalitions in ATM Markets*

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Abstract

This paper studies ATM coalitions in retail banking. We ask when it is profitable for banks to make agreements which ban direct ATM transaction fees. In the case of a coalition banks loose income from ATM transactions but relax competition in the banking market. We find that such agreements are profitable when the interchange fee is sufficiently high. When banks can collude on the interchange they always form a coalition. Coalitions may harm consumers but lead to higher total welfare. Moreover, we find that smaller banks have larger incentives to form ATM coalitions. Investment in ATM networks is typically higher with a coalition.

Keywords: Banking competition, ATM networks, collusion
JEL-Classification: L1, G2

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1 Introduction

Banks offer a variety of services to their customers. For instance, they provide consumers with account and payment services, give investment advice or grant credit facilities. Additionally, banks provide customers with ATM services, that is, facilities to withdraw money outside their own branches. Competition in ATM markets will be the focus of this paper.

The ATM market is interesting as several different fees can be applied to one transaction. When a depositor of a bank makes a foreign withdrawal, that is, he withdraws money from an ATM which is not owned by the bank where he has an account, up to three different fees can be charged: a foreign fee, a surcharge fee, and an interchange fee. A foreign fee is a fee that is charged by the cardholder's bank to the depositor. The cardholder can also be charged by the ATM owner via a surcharge fee. Finally, there may be an interchange fee from the cardholder's bank to the ATM owner.

Pricing of ATM services differs widely among countries. In the US, for instance, all three possible fees are applied to foreign withdrawals. Consumer pay high direct transaction fees for getting cash. In contrast, in Finland or in Belgium there are no direct usage fees. The same is true for the UK. Here the majority of ATMs operated through the LINK system can be accessed without charges. Finally, in some countries only surcharge fees are applied to foreign withdrawals. This is (at least partially) the case, for instance, in Germany.

The present paper focuses on banks' preferences towards these different pricing structures and asks which pricing structure emerges when banks can coordinate on a specific structure. There is some evidence that banks cooperate in their choice of pricing. In Germany some banks have entered mutually into agreements with each other to exempt their customers mutually from surcharge and foreign fees, that is, customers of a bank A can also use ATMs owned by bank B without any charges, and vice versa. There are several competing industry associations which have been forcefully marketed by the participating banks under the names 'Cash Group' and 'CashPool'.[1] Inside these association foreign withdrawals are costless for consumer, but surcharges are charged when using an ATM of a competing banking association. That is in Germany, there are two pricing structures. Further examples for banking cooperation on price structur are Finland and Belgium. In these two countries there exists a single ATM network in which

[1]These agreements exempt depositors of one participating bank of any charges when using ATMs owned by another participating bank. The 'Cash Group' consists of Commerzbank, Deutsche Bank, Dresdner Bank, Hypovereinsbank and the Postbank. 'CashPool' is a similar arrangement between various smaller banks. The Sparkassen-association has a similar agreement among their members.

nearly all banks participate (Ferrari, Verboven, and Degryse, 2007; Snellman and Viren, 2006).[2]

Guided from the experience within Germany, and across the US versus Belgium and Finland, our specific focus is on a comparison between two pricing structures. We compare the incentives to choose between two pricing menus: In one, banks can apply all three possible fees to foreign transactions (US) while in the second there are no direct usage fees for consumers (Finland and Belgium). We will analyze these choices in symmetric and asymmetric banking industries. We also study investment behavior in the ATM network induced by the different pricing structures.

At a first glance, it is not clear why banks should agree not to charge certain services, that is, waive revenues from ATM services. According to this intuition consumers should benefit by these agreements as a larger ATM network is available without any charges.. However, this intuition lacks the insight that the market for ATM transactions and the market for deposit accounts (or ATM cards) is linked. The purpose of the present paper is to shed light on the question when and why banks make such agreements and waive revenues from ATM transactions. In line with other theoretical studies in ATM markets we will show that by exempting customers from ATM usage fees, banks can weaken competition in the market for banking services, and thereby increase account fees. The reason for this result lies in the impact of interchange fees on the degree of banking competition. Previous literature has shown that collectively set interchange fees may serve as a device to relax competition in the banking market (Matutes and Padilla, 1994; Donze and Dubec, 2006; Chioveanu, Fauli-Oller, Sandonis, and Santamaria, 2007). However, it is also known that this impact of interchange fees is offset if banks charge consumers surcharge and foreign fees additionally. Thus, by banning direct usage fees on ATM transaction, banks can decrease competition for customers and increase their income from account fees. When the increase in profits due to weaker competition is larger than the loss in revenues from ATM transactions, banks enter into agreements to ban direct usage fees. As the motive not to charge direct ATM usage fees is a strategic one we call this type of cooperation a *strategic ATM coalition.*

We construct a duopoly model of banking competition where consumers derive benefits from general banking services and ATM services. In the base model, two banks with symmetric ATM networks have the option to form a strategic ATM coalition. If they form one, they waive direct ATM usage fees. If they decide not to, consumers are charged for the use of foreign ATMs. In the model, consumers decide which bank to join and whether or not to withdraw money from an ATM. In this setup, we find that banks enter

[2] In Finland and in Belgium (until recently) cooperation between banks goes further than in Germany. Decisions about ATM deployment are also made at a cooperative level.

a strategic ATM coalition when the interchange fee is sufficiently high. By forming a coalition, banks can use interchange fees and hence high account fees to capture consumer surplus. Furthermore, when banks can determine the interchange fee cooperatively they choose an interchange fee that is so high that it is always profitable to form a coalition. The reason is that via abandoning direct ATM usage charges banks can implement the optimal ATM use whose benefits can extracted via a fixed fee (account fee). Turning to welfare implications, we find that ATM coalitions may reduce consumers surplus if the interchange fee is too high as most of the surplus is captured via high account fees. These account fees, however, have no impact on total welfare as they constitute transfers between consumers and banks. Total welfare depends solely on the efficiency of ATM use. When banks form a coalition ATM use is efficient such that total welfare is higher with an ATM coalition.

Extending the base model, we depart from the assumption of symmetric network sizes. We analyze the case where one bank operates a larger network than its competitor. In the case of direct ATM usage charges this introduces an aspect of vertical differentiation among banks. Consumers prefer banks with a large own network which can be used without charges. A large network of the foreign bank is costly for consumers. Forming a coalition, and hence abandoning foreign and surcharge fees, eliminates this vertical differentiation. The network of both banks can be accessed by depositors without costs. This in turn leads to banks with smaller networks having a stronger incentive to form an ATM coalition. Consequently, it can also be shown that the formation of coalitions is more likely when banks' networks are of similar size. We also consider the incentives to invest in the size of the ATM network. Provided that the interchange fee is sufficiently high we find that ATM deployment is higher when banks have formed a coalition. Thus, high interchange fees provide powerful incentives for investment.

The incentives to form agreements which ban voluntarily ATM transaction charges is also studied in Croft and Spencer (2004). In contrast to the present paper, they only consider the incentive to ban surcharges. The present paper considers agreements to ban all direct charges on customers, that is, surcharge and foreign fees. Both, the present paper and the model in Croft and Spencer (2004) consider the implications for asymmetric banks. However, the papers differ in the way asymmetry is introduced. In Croft and Spencer (2004) banks may differ in customer base, while in the present paper banks can differ in the size of their ATM networks. Consumers choice which bank to choose is endogenous in our approach. This difference also leads to different conclusions. Croft and Spencer (2004) conclude that large banks have stronger incentives to agree on no-surcharging agreements. In contrast, the present paper, comes to the opposite result, namely that smaller banks have the stronger incentive. Moreover, in contrast to Croft and Spencer

(2004), the present paper considers the welfare implications of ATM coalitions and the incentives to invest in ATM networks.

There is a growing literature concerned with ATM networks—both theoretical and empirical. For a recent review see the article by McAndrews (2003). On the theoretical side, Matutes and Padilla (1994) study the question of compatibility of ATM networks. Donze and Dubec (2006) study the impact of interchange fees on the degree of banking competition and ATM deployment. In a model without surcharge and foreign fees, they show that interchange fees can be used as a collusive device. Furthermore, ATM deployment is too high from a welfare point of view as banks deploy ATMs aggressively in order to earn interchange fees. Massoud and Bernhardt (2005) are also concerned with ATM deployment. They find that there is overprovision of ATMs. The reason is that banks can use these ATMs to extract profits from non-depositors. The question whether surcharging should be banned is studied in several papers (Massoud and Bernhardt, 2002; Chioveanu, Fauli-Oller, Sandonis, and Santamaria, 2007; Fauli-Oller, 2007; McAndrews, 2001; Croft and Spencer, 2004). However, results are mixed. In Massoud and Bernhardt (2002) and Croft and Spencer (2004), surcharges should be banned, while in Chioveanu, Fauli-Oller, Sandonis, and Santamaria (2007) and Fauli-Oller (2007) they should be allowed.

On the empirical side there is also a growing interest on outcomes in ATM markets. There is particular interest in the impact of surcharging on market outcomes. The impact of surcharging on competition between large and small banks is studied by Prager (2001) and Massoud, Saunders, and Scholnick (2006). The impact of surcharging on market concentration is studies in Hannan (2007). Hannan and Borzekowski (2007) and Ishii (2005) consider surcharging and investment in ATM networks. Knittel and Stango (2008b) establish empirically strategic motives to excessively increase surcharge fees to gain a competitive advantage. Knittel and Stango (2008a) explore the welfare effects of surcharging. They find that surcharging increases welfare by leading to more ATM deployment.

The outline of the paper is as follows. Section 2 sets up the model framework. Section 3 analyzes the case when banks do not form an ATM coalition, that is, they charge ATM usage fees. Section 4 studies the outcome when banks form a coalition in order to abstain from ATM usage fees. Section 5 analyzes the incentives to form an ATM coalition, while section 6 looks at welfare consequences. Section 7 studies coalitions among banks with asymmetric networks. Section 8 studies investment in ATM networks. Finally, section 9 concludes.

2 The model

This section introduces the model. We use a setup similar to Chioveanu, Fauli-Oller, Sandonis, and Santamaria (2007) and Croft and Spencer (2004).

Banks

We consider a duopoly banking market. Two banks are located at the outer extremes of a [0,1] - line. Bank 1 is located at zero, while bank 2 is located at one. The banks provide two services: general banking services and ATM services.

The costs for providing these services is normalized to zero. A bank can charge customers an account fee, F_i, for the general banking services when a consumer opens an account with the bank. They can also charge for the use of ATM services. We assume that banks do not charge 'on-us' fees, that is, customers of bank i can use its ATMs without charges.[3] The ATM use of a customer of bank i of an ATM owned by bank j involves three different fees. First, bank j can charge a surcharge fee, s_j, directly to the consumer. Second, bank j can charge bank i an interchange fee, a. Third, bank i can charge its customer a foreign fee, f_i.

We study the question when it is beneficial for banks to make agreements to ban direct fees for ATM transactions. We thus contrast two different scenarios. Banks can make an agreement to ban direct ATM transaction fees on customers, that is, surcharges and foreign fees are not allowed. Interchange fees between banks are still possible. We will call this agreement a *strategic ATM coalition*. We contrast this with the outcome when banks charge direct ATM transaction fees for foreign withdrawals.[4]

Consumers

Consumers are located uniformly on the same [0,1]-line. The variable x denotes the location of a consumer. The number of consumers is normalized to one. They derive utility from the two services provided by the banking industry. When opening an account with a bank, consumers get a gross utility of V from the general banking service. Consumers' transportation costs

[3]The price for on-us withdrawals can be viewed as included in the account fee F_i.

[4]Chioveanu, Fauli-Oller, Sandonis, and Santamaria (2007) compare ATM pricing with and without surcharges while foreign fees are always applied. In our setup, an agreement not to charge surcharge and foreign fees always leads to higher profits than an agreement that only bans surcharges while still charging foreign fees. That is in our model banks do not have an incentive to ban only surcharges.

are linear in distance. There is a parameter t associated with transportation costs.

The second source of utility for consumers are ATM services, that is, the possibility to withdraw money at ATM machines. We assume that consumers experience a(n) (unanticipated) need for cash and search for an ATM. With a probability of P_1 a consumer finds an ATM of bank 1, and with probability P_2 he finds an ATM of bank 2.[5] These probabilities depend on the size of the ATM networks. In the base model, we assume that these probabilities are exogenous.[6] We assume that $P_1 + P_2 \leq 1$. Hence, a consumer may not find any ATM. In the base model, we assume additionally that network sizes are identical and hence, $P_1 = P_2 = P$. Later, we drop this assumption and analyze asymmetric networks. If a consumer finds an ATM, the gross benefit of an ATM transaction is v. We assume that v is uniformly distributed on [0,1], that is, consumers have different valuations for withdrawing money. Fees for the withdrawal are subtracted from the gross utility. In case a consumer does not find any ATM he receives zero utility.

Total consumer utility then is:

$$U = V - td_i - F_i + u_{ATM}, \tag{1}$$

where d_i denotes the distance between consumer and bank i's location, and u_{ATM} is the utility provided by ATM services.

We make the following assumption on parameter values:

Assumption 1

$$V \geq \frac{3}{2}t - \frac{5}{9}P.$$

Assumption 1 ensures that all consumers choose to open an account in the case when banks do not form a coalition. That is the market is covered.

Timing

We assume the following time structure:

[5] This search behavior by consumers is in contrast to spatial ATM models where consumers know the location of ATMs and decide over ATM use in terms of distance and prices. An example for this approach is Croft and Spencer (2004) or Matutes and Padilla (1994). In the present model, consumers do not know ATM locations. They search for an ATM and decide on the use of the first one they encounter. A similar approach is used in Chioveanu, Fauli-Oller, Sandonis, and Santamaria (2007) and Fauli-Oller (2007).

[6] In section 8, we will depart from this assumption and analyze the incentives to invest in the size of the ATM network.

Stage 1: Banks decide whether to form an ATM coalition

Stage 2: Banks decide cooperatively on the interchange fee (a)

Stage 3: Banks set account fees, F_i, non-cooperatively

Stage 4: Consumers decide where to open an account

Stage 5: Banks decide on ATM usage fees (surcharge s_i and foreign fee f_i) non-cooperatively in case of no coalition

Stage 6: Consumers valuation for ATM services is drawn from v, and consumers decide on ATM use

This time structure assumes that banks decide on transaction costs after consumers have chosen banks. Hence, ATM transaction costs cannot be used strategically to attract customers. This time structure—also employed in Croft and Spencer (2004) and Chioveanu, Fauli-Oller, Sandonis, and Santamaria (2007)—assumes a lock-in of consumers.[7] As is current practice, we assume that interchange fees are set collectively by banks. In the following, we will analyze this six-stage game. We look for a subgame perfect equilibrium.

3 No strategic ATM coalition

We start by analyzing the outcome when banks do not form a strategic ATM coalition. In this case, direct transaction fees for consumers are charged when using a foreign ATM. Additionally, interchange fees between banks can be charged.

Consumer deciding on ATM use

In stage 6, consumers encounter an ATM with an exogenous probability and decide whether to use it or not. The benefit a consumer derives from withdrawing money is a random draw of v. If a consumer encounters an ATM he compares the benefits with the costs.

When using an ATM owned by j, a customer of bank i has to pay foreign fees (f_i) charged by his own bank and surcharges (s_j) charged by the ATM owner. Thus, a consumer uses a foreign ATM if $v > f_i + s_j$. The random

[7]In an extension to their model, Croft and Spencer (2004) also analyze the case when ATM usage fees are set at the same stage as account fees. Then, ATM usage fees can be used strategically to attract customers. They show that with this time structure foreign fees are lower to make own accounts more attractive and that surcharges are higher to make rivals' accounts less attractive.

variable v is uniformly distributed on [0,1]. Hence, a fraction $(1 - f_i - s_j)$ of consumers uses the foreign ATM. Note that in the presence of surcharge and foreign fees, ATM use is inefficiently low. As there are no costs associated with the withdrawal of money, the efficient benchmark is that all consumers decide to withdraw.

Banks choosing transaction fees

In stage 5, banks set foreign and surcharge fees non-cooperatively. The interchange fee a is exogenous at this stage. As consumers have already chosen where to open an account, banks set these fees to maximize profits from ATM operations.

Banks receive revenues from depositors as well as from non-depositors. Own transactions are irrelevant for profits as they are priced at zero. Let $\bar{x}$ denote the share of depositors at bank 1, and $(1 - \bar{x})$ the share of depositors at bank 2. If a depositor of bank 2 uses an ATM of bank 1, bank 1 receives a surcharge and an interchange fee. The fraction of bank 2 depositors that encounter an ATM of bank 1, is $(1 - \bar{x})P$. Of those a fraction of $(1 - s_1 - f_2)$ decides to withdraw money. Hence, revenues from non-depositors are $(1-\bar{x})P(1-s_1-f_2)(s_1+a)$. From depositors banks receive foreign fees but have to pay an interchange fee to the ATM owner $(f_1 - a)$. The fraction of consumer encountering and using a foreign ATM is $\bar{x}P(1 - s_2 - f_1)$. Hence, total revenues from depositors are $\bar{x}P(1 - s_2 - f_1)(f_1 - a)$. Taken together, the profits bank 1 receives from ATM transactions can be expressed as

$$\Pi_1^{ATM} = (1 - \bar{x})P(1 - s_1 - f_2)(s_1 + a) + \bar{x}P(1 - s_2 - f_1)(f_1 - a). \quad (2)$$

A similar expression holds for bank 2. Banks decide non-cooperatively on their charges. Maximizing profits leads to the following fees: $s^* = \frac{1}{3} - a$ and $f^* = \frac{1}{3} + a$. The total price for using a foreign ATM is then $s^* + f^* = \frac{2}{3}$. Note that the total costs of ATM use are higher than the costs, thus, ATM use at foreign ATMs is inefficiently low. Note also that this price is independent of the interchange fee.

Inserting equilibrium charges into profits from ATM transactions yields $\hat{\Pi}_1^{ATM} = \frac{P}{9}$, which is also independent of the interchange fee. This irrelevance result of the interchange fee when additionally surcharge and foreign fees are applied emerges also in Croft and Spencer (2004) and Chioveanu, Fauli-Oller, Sandonis, and Santamaria (2007).

Consumer choosing banks

In stage 4, consumers decide at which bank to open an account. The expected utility a consumer derives from ATM transaction consists of three parts. With probability P, the consumer encounters an ATM of the bank where he is depositor, leading to expected utility of $\frac{1}{2}$. With the same probability of P, he encounters an ATM of the foreign bank, leading to an expected utility of $\frac{1}{18}$.[8] With a probability of $(1-2P)$, he does not find any ATM and receives zero utility.

Taking gross benefits from general banking services, account fees and transportation costs into account, the utility of a consumer x when joining bank 1 and bank 2, respectively, are:

$$U_1 = V - tx - F_1 + P\frac{1}{2} + P\frac{1}{18}, \tag{3}$$

$$U_2 = V - t(1-x) - F_2 + P\frac{1}{2} + P\frac{1}{18}. \tag{4}$$

Equating these two equations gives the marginal consumer $\bar{x}$:

$$\bar{x} = \frac{1}{2} + \frac{F_2 - F_1}{2t}. \tag{5}$$

As banks are symmetric market share is only determined by account fees. Consumers with a lower value of $\bar{x}$ choose bank 1, while those with a higher value choose bank 2. The market share of bank 1 is $\bar{x}$ and that of bank 2 is $(1-\bar{x})$.

Banks choosing account fees

In stage 3, banks set account fees non-cooperatively. Taking into account profits from the ATM transactions, profits of the two banks are:

$$\Pi_1 = \bar{x}F_1 + \frac{P}{9}, \tag{6}$$

$$\Pi_2 = (1-\bar{x})F_2 + \frac{P}{9}. \tag{7}$$

Maximization of profits leads to account fees of $F_1 = F_2 = F = t$. Assumption 1 ensures that the market is covered, that is, all consumers choose to open an account. Inserting the equilibrium account fee into the profit function leads to the following symmetric equilibrium profits:

$$\Pi = \frac{1}{2}t + \frac{P}{9}. \tag{8}$$

[8] To withdraw non-depositors pay total fees of $\frac{2}{3}$, that is only those consumers with $v \geq \frac{2}{3}$ withdraw. Hence, a priori with a probability of $\frac{2}{3}$ a consumer does not use the ATM and receives zero utility. With a probability of $\frac{1}{3}$ a consumer withdraws. In this case, the conditional expected utility is $\frac{\frac{2}{3}+1}{2} - (\frac{2}{3}) = \frac{1}{6}$. The expected utility from ATM use is hence $\frac{1}{3} * \frac{1}{6} = \frac{1}{18}$.

The first part expresses profits from account fees, the latter term is the profit from ATM transactions. Profits increase with network size as a larger network leads to more ATM transactions. Furthermore, higher transportation costs t lead to larger profits as competition between banks is weaker.

4 Strategic ATM coalition

Suppose now that banks have formed a coalition and have agreed not to charge surcharge and foreign fees. Thus, there are no transaction costs for consumers for using ATMs—neither for using own bank's nor for foreign bank's ATMs. The only fee that is involved in ATM transactions is the interchange fee between banks. In contrast to the section above, interchange fees now become relevant. As in the model by Donze and Dubec (2006), interchange fees now serve as collusive device to reduce the intensity of competition.

Consumer deciding on ATM use

As banks charge neither foreign fees nor surcharge fees, ATM transactions are without costs for consumers. Each consumer uses the ATM he encounters, and hence, ATM use is efficient.

Banks choosing transaction fees

Banks have agreed not to charge transaction fees.

Consumer choosing banks

In stage 4, consumers choose at which bank to open an account. Consumers encounter and use an ATM with probability $2P$. Hence, the expected utility from ATM transactions is $\frac{1}{2}2P = P$.

The utility for a consumer x when choosing bank 1 is:

$$U_1 = V - tx - F_1 + P. \tag{9}$$

The utility when choosing bank 2 is:

$$U_2 = V - t(1-x) - F_2 + P. \tag{10}$$

Equating these two equation leads to

$$\bar{x} = \frac{1}{2} + \frac{F_2 - F_1}{2t}. \tag{11}$$

Banks choosing account fees

In stage 3, banks set account fees non-cooperatively as to maximize their profits. Profits consist of two parts: Account fees and interchange income from ATM transactions. Profits of bank 1 and 2 are:

$$\Pi_1 = \underbrace{\bar{x}F_1}_{\text{Account fee income}} + \underbrace{(1-\bar{x})Pa}_{\text{Interchange fees received}} - \underbrace{\bar{x}Pa}_{\text{Interchange fees paid}}, \tag{12}$$

$$\Pi_2 = \underbrace{(1-\bar{x})F_2}_{\text{Account fee income}} + \underbrace{\bar{x}Pa}_{\text{Interchange fees received}} - \underbrace{(1-\bar{x})Pa}_{\text{Interchange fees paid}}. \tag{13}$$

Maximizing profits with respect to F_1 and F_2, respectively, and solving for equilibrium values yield the following account fees chosen by both banks:

$$F^* = F_1^* = F_2^* = t + 2Pa. \tag{14}$$

Higher interchange fees and larger network sizes lead unambiguously to higher account fees. Higher interchange fees lead to a higher price by weakening competition for customers. As banks can earn fees from non-depositors via ATM transactions they are less keen on attracting customers (Donze and Dubec, 2006).[9] Note that in equilibrium interchange fees paid and received exactly cancel.

Given equilibrium account fees, profits of the banks can be expressed as:

$$\Pi_i^* = \frac{1}{2}t + aP. \tag{15}$$

This equation gives banks' profits when the interchange fee is exogenous. As profits increase with the interchange fee banks have an incentive to collude on a high interchange fee.

5 The incentives to form a strategic ATM coalition and the choice of the interchange fee

This section studies the incentives to form an ATM coalition and the choice of the interchange fee. Agreeing not to charge direct ATM fees to consumers invokes a trade-off. When banks do not form a coalition they receive profits

[9] In telecommunication industries a similar result may arise. There access fees to access rivals' networks can act as a device of collusion (Armstrong, 1998; Laffont, Rey, and Tirole, 1998).

from both account fees and ATM transactions paid by depositors. When they form a coalition, banks receive only income from account fees (interchange fees paid and received cancel), which are, however, higher than in the no-coalition case. Banks form a strategic coalition whenever the profits from higher account fees are higher than the loss in income from ATM transactions. In Croft and Spencer (2004) banks may form coalitions for a different reason. Banks make agreements as surcharging raises the price of ATM transactions above the level that maximizes joint profits. By banning transaction fees, banks can increase their profits.

We start to analyze the incentives to form a coalition by focusing on an exogenous interchange fee. Comparing profits (given by equations (8) and (15)), we can derive the following result:

Result 1 *When the interchange fee is exogenous, banks form a coalition whenever* $a > \frac{1}{9}$.

The intuition behind this result is clear. As a high interchange fee increases profits only in the case of a coalition, and not in the case of no coalition, banks find it profitable to form coalition if the interchange fee is sufficiently high.

Now we consider the case of an endogenous interchange fee. We assume here that banks set the interchange cooperatively. As profits for both banks increase in the interchange fee, banks set the highest interchange fee possible. The highest possible interchange fee—assuming that banks want to serve all consumers—is the interchange fee that makes the marginal consumer located at $x = \frac{1}{2}$ just indifferent between opening an account and not opening:

$$V - F(a^*) + P - \frac{1}{2}t = 0, \tag{16}$$

which leads to

$$a^* = \frac{2V - 3t}{4P} + \frac{1}{2}. \tag{17}$$

Note that higher transportation costs lead to a lower interchange fee. When transportation costs are high, consumers are less willing to travel, and hence banks have to charge lower account fees (interchange fees) to get consumers opening an account. Thus, interchange fees are high when competition between banks is high (low t) and they are low when competition is tough (high t). Given this interchange fee account fees are $F = V + P - \frac{1}{2}t$.

Inserting the optimal interchange fee into equation (15) yields the profits earned by each bank when they have formed a coalition:

$$\Pi = \frac{1}{2}(V + P) - \frac{1}{4}t. \tag{18}$$

Note that profits increase with the gross benefit of general banking services as they can be captured via higher account fees. Interestingly, profits decrease with transportation costs, that is weaker competition among banks leads to lower profits. As already indicated above, there are two effects at work here—a direct and an indirect one. The direct effect is that for given interchange fees weaker competition leads (higher t) leads to larger profits. The indirect effect works via the interchange fees. Weaker competition leads to smaller interchange fees which impact negatively on profits. In this model, the indirect effect dominates, and hence profits are higher when competition is tough in the case of a coalition.

Comparing profits with and without coalition we find:

Result 2 *Suppose banks choose the interchange fee cooperatively, then banks do always form a coalition.*

Proof. Banks form a coalition if $\frac{1}{2}(V+P) - \frac{1}{4}t > \frac{1}{2}t + \frac{P}{9}$ which can be expressed as $V > \frac{3}{2}t - \frac{7}{9}P$. Under assumption 1 this condition is always fulfilled.

The intuition behind result 2 is simple. By forming a coalition and abandoning direct ATM charges, banks can implement the welfare optimal level of ATM use. The associated surplus can then be extracted via high account fees.

6 Welfare analysis

This section considers the welfare implications. We analyze the impact of ATM coalitions on consumer surplus and total welfare and ask whether there are Government interventions that could improve the market outcome.

Consumer surplus in the case of a coalition and of no coalition, respectively, are:

$$CS^c = V - \frac{5}{4}t + P - 2aP, \tag{19}$$

$$CS^n = V - \frac{5}{4}t + \frac{5}{9}P. \tag{20}$$

We define total welfare as the sum of consumer surplus and banks' profits:

$$W^c = V - \frac{1}{4}t + P, \tag{21}$$

$$W^n = V - \frac{1}{4}t + \frac{7}{9}P. \tag{22}$$

Comparing consumer surplus and total welfare with and without coalition, the following result can be obtained:

Result 3 *Welfare analysis with exogenous interchange fee. i) Consumer surplus is lower under an ATM coalition if* $a > \frac{2}{9}$*. ii) Total welfare is higher under an ATM coalition.*

The results of the welfare analysis are not surprising. Consumer surplus is lower under a coalition if the interchange fee is sufficiently high as a high interchange fee lead to high account fees. Contrary, total welfare is higher with an ATM coalition. For total welfare high account fees do not matter as they constitute transfers between consumers and banks. Relevant for total welfare is only ATM use. When banks charge transaction fees, ATM usage is inefficiently low (see section 3), contrary when banks do not charge fees ATM use is at the efficient level. Hence, in consequence, the ATM coalition maximizes total welfare.

When the interchange fee is chosen endogenously by banks, our welfare results change to:

Result 4 *Welfare analysis with endogenous interchange fee. i) Consumer surplus is lower under an ATM coalition. ii) Total welfare is higher under an ATM coalition.*

The implications for total welfare are unchanged. However, when banks set the interchange fee collectively, consumers are unambiguously worse off as the interchange fee is set in such a way that the marginal consumer is extracted any surplus. Thus, from a consumer's point of view ATM coalitions among banks should be prohibited.

Our welfare analysis points to the potential of a Government intervention via regulation of the interchange fee. Interchange fees could be regulated in such a way that banks still favor the agreement but leave consumer with a higher surplus. In this model a good intervention would be to regulate the interchange fee at a level of $a = \frac{1}{9}$ (or slightly above). In this case banks would form a coalition and hence total welfare is maximal. Also consumer surplus is highest, constrained only by inducing banks to form a coalition. Note that in this model the interchange fee should be regulated at a higher level than the costs for providing ATM services.

7 Asymmetric networks

In the analysis above, we have assumed that ATM networks of both banks are symmetric. This section extends the base model to banks with asymmetric network sizes. We now assume that bank 1 operates a larger network, that is, $P_1 > P_2$.[10] By introducing banks with different ATM network sizes we add an aspect of vertical differentiation into the model. In the case banks do not form a coalition joining a bank with a larger network is beneficial for consumers as they have more opportunities to withdraw cash without charges. In the case of a coalition the aspect of vertical differentiation is not present. Consumers can use both banks' networks without charges.

No strategic ATM Coalition

We repeat the analysis of the base model starting with the case of no coalition.

As consumers are locked in, transaction fees are unchanged to the base model. However, consumer now care for who owns a larger network. Consumers derive the following utility levels when joining bank 1 and bank 2, respectively:

$$U_1 = V - tx - F_1 + P_1\frac{1}{2} + P_2\frac{1}{18}, \tag{23}$$

$$U_2 = V - t(1-x) - F_2 + P_2\frac{1}{2} + P_1\frac{1}{18}. \tag{24}$$

As $P_1 > P_2$, bank 1 offers ceteris paribus a higher utility to depositors. Equilibrium account fees are then:

$$F_1 = 1 + \frac{5}{27}\left(P_1 - P_2\right), \tag{25}$$

and

$$F_2 = 1 - \frac{5}{27}\left(P_1 - P_2\right). \tag{26}$$

Bank 1 charges a higher account fee due to its larger network. Additionally, bank 1 has a larger market share, leading to higher profits from account fees. From ATM transactions both banks earn the same income as margins from surcharging and foreign fees are the same.[11] Profits are then:

$$\Pi_1 = \frac{1}{2} + \frac{5}{27}P_1 - \frac{2}{27}P_2 + \frac{2}{729}(P_1 - P_2)^2, \tag{27}$$

$$\Pi_2 = \frac{1}{2} + \frac{5}{27}P_2 - \frac{2}{27}P_1 + \frac{2}{729}(P_1 - P_2)^2. \tag{28}$$

[10]Without loss of generality and for ease of exposition from now on we normalize transportation costs to $t = 1$. We modify assumption 1 to $V \geq \frac{3}{2} - \frac{5}{18}(P_1 + P2)$.

[11]Bank 1 receives a larger fraction of ATM income from surcharge fees than from foreign fees. Bank 2 receives more from foreign fees than from surcharging.

Strategic ATM coalition

Now suppose that banks have formed an ATM coalition, that is, banks do not charge direct transaction fees for ATM services. Hence, consumers do not care about who owns the network and hence the aspect of vertical differentiation present in the case of no coalition disappears. Consequently and in contrast to the case without a coalition, banks charge identical account fees: $F = 1 + a(P_1 + P_2)$. However, as bank 1 has a larger network than bank 2, it receives more income from ATM transactions. Bank 1 receives interchange fees of $\frac{1}{2}a(P_1 - P_2)$ while bank 2 has an outflow of the same amount.

Adding profits from account fees and ATM transactions, banks earn the following profits:

$$\Pi_1 = \frac{1}{2} + aP_1, \tag{29}$$

and

$$\Pi_2 = \frac{1}{2} + aP_2. \tag{30}$$

Note that even in the case of asymmetric networks both banks benefit from a higher interchange. However, there are two effects at work. First, a higher interchange fee leads to higher account fees which is positive for both banks. Second, a higher interchange fee leads to higher income from ATM transactions for the larger bank 1, and to lower income for bank 2. For the large bank, both effects are positive. For the smaller bank, the two effects oppose each other, yet, the account fee effect dominates. The interchange fee that maximizes profits for both banks is $a = \frac{1}{2} + \frac{2V-3}{2(P_1+P_2)}$, leading to profits of

$$\Pi_1 = \frac{1}{2} + \frac{1}{2}P_1 + \frac{(2V-3)P_1}{2(P_1+P_2)}, \tag{31}$$

$$\Pi_2 = \frac{1}{2} + \frac{1}{2}P_2 + \frac{(2V-3)P_2}{2(P_1+P_2)}. \tag{32}$$

The incentives to form a coalition

Banks now face different incentives to form a coalition. A coalition can only be achieved if it leads to higher profits for both banks. Comparing profits, bank 1 benefits from the agreement whenever $a \geq a_1$, with

$$a_1 = \frac{5}{27} - \frac{2}{27}\frac{P_2}{P_1} + \frac{2}{729}\frac{(P_1 - P_2)^2}{P_1}. \tag{33}$$

Bank 2 benefits when $a \geq a_2$, where

$$a_2 = \frac{5}{27} - \frac{2}{27}\frac{P_1}{P_2} + \frac{2}{729}\frac{(P_1 - P_2)^2}{P_2}. \tag{34}$$

Note that $a_1 > a_2$. That is the bank with the smaller network has a larger incentive to form a coalition. Hence, when $a < a_2$, no bank wants to form a coalition. When $a_2 \leq a < a_1$ only the small bank wants to establish a coalition. Thus, no agreement emerges and the coalition is not established. When $a \geq a_1$, both banks agree to ban direct ATM transaction fees on depositors. Hence, the strategic ATM coalition is formed.

As $a_1 > a_2$, we notice that the smaller bank gains more from forming a coalition. The reason is a re-distribution of customers from the large to the small bank in case of a coalition. When there is no coalition, consumers tend to favor the bank with the larger network, thus a small bank has to reduce account fees. When forming a coalition the smaller bank is no longer disadvantaged in attracting depositors. Consumers do not care about who owns an ATM (but only about the size of the entire network). Thus by forming a coalition, a small bank can increase the account fee as well as the number of depositors at the expense of the larger competitor. Here our results differ from Croft and Spencer (2004). In Croft and Spencer (2004) large banks gain more from no-surcharging agreements. The reason in their model is that banks with a larger depositor base receive less revenues from surcharges.

To study the impact of the degree of asymmetry in network sizes on the establishment of a coalition, we consider the case where $P_1 + P_2 = 1 \Leftrightarrow P_1 = 1 - P_2$, that is, each consumer finds an ATM for sure. We make this assumption to filter out the impact of an increase in overall network size and focus on the impact of asymmetry leaving coverage constant. As $P_1 > P_2$, an increase in P_2 leads to more equal network sizes. It can be shown that $\frac{\partial a_1}{\partial P_2} < 0$. Hence, the establishment of a coalition is more likely when ATM networks are more equal.

Summarizing our results:

Result 5 *Suppose bank 1 operates a larger network than bank 2 and the interchange fee is given exogenously. Then, i) banks form a coalition whenever $a \geq a_1$, ii) the bank with a smaller network has a larger incentive to form an ATM coalition, and iii) more equal network sizes make the establishment of an ATM coalition more likely.*

Now suppose that banks set the interchange cooperatively. Then our result from the symmetric case carries over, the reason being that the cooperative interchange fee is high enough to induce both banks to favor a coalition.

Result 6 *Suppose bank 1 operates a larger network than bank 2 and the interchange fee is set cooperatively. Then banks always favor a coalition.*

8 Investments in ATM Networks

Until now we have considered the size of ATM networks as exogenously given. In this section, we study the incentives to invest in the size of ATM networks. We modify our game as follows: After banks have made network-wide decisions (form a coalition, interchange fees) in stages 1 and 2, banks choose non-cooperatively the size of their networks. The remainder of the game remains unchanged. The number of ATMs deployed by bank i is n_i. There is a unit cost for deploying ATMs which is given by c.

We assume that the probability of encountering an ATM of bank i depends on ATM deployment in the following way:[12]

$$P_i = \frac{n_i}{n_i + n_j}. \tag{35}$$

Banks with a larger network have more ATM customers. Implicitly, by using this specific functional form, we assume that each consumer finds an ATM as $P_i + P_j = 1$.

In the analysis, we can make use of the results in section 7 on asymmetric network sizes. When banks have not formed a coalition, banks profits at the relevant stage can be expressed by equation (27) and subtracting deployment costs:

$$\Pi_i = \frac{1}{2} + \frac{5}{27}P_i - \frac{2}{27}P_j + \frac{2}{729}(P_i - P_j)^2 - cn_i, \tag{36}$$

where P_i and P_j are as defined above. Each bank chooses the number of ATMs to maximize profits non-cooperatively. The symmetric number of ATMs deployed by each bank is then $n^n = \frac{7}{108c}$, leading to profits of $\Pi^n = \frac{53}{108}$.

Assuming that banks have formed a coalition, equation (29) gives banks profits' relevant for the ATM deployment decision. Subtracting costs of investing in the ATM network then gives:

$$\Pi_i = \frac{1}{2} + aP_i - cn_i. \tag{37}$$

The resulting equilibrium deployment is $n^c = \frac{a}{4c}$. A higher interchange fees leads to more investment. Inserting the optimal interchange set collectively by the duopoly banks, ATM deployment is $n^c = \frac{V-1}{4c}$. Profits are then $\Pi^c = \frac{1}{2} + \frac{V-1}{4} = \frac{V+1}{4}$.

[12] The same functional form is used in Donze and Dubec (2006).

Comparing ATM deployment in the two different states and analyzing the decision to establish a strategic coalition, we get:

Result 7 *i) In the case of an exogenous interchange fee, ATM deployment is higher when banks have formed a coalition if* $a > 7/27$. *ii) In the case of an endogenous interchange fee, ATM deployment is higher when banks have. formed a coalition. iii) Banks do always favor a coalition.*

This result shows that high interchange fees may provide a powerful mechanism to invest in ATM network size. This has also been shown in Donze and Dubec (2006). In the case banks have formed a coalition investment is higher than in the case of no coalition if the interchange fee is sufficiently high. The reasons for deployment differ with and without coalition. In the case of a coalition, banks do so to receive interchange fees from non-depositors. In contrast, when banks have not formed a coalition, banks invest in ATMs to attract depositors.

We find that for any positive interchange fee banks prefer to form a coalition and not to charge ATM customers directly, even though investment costs may be higher. When banks have formed a coalition, a high interchange fee has two effects on bank profits. First, it relaxes competition and second, it induces higher investment. However, the overall effect on profits is still positive and banks still prefer the highest possible interchange fee.

9 Conclusion

The aim of this paper is to analyze the incentives to form coalitions among banks in ATM markets. A coalition is here a contract between banks that bans direct fees on consumers for ATM transactions. The formation of such a coalition has two opposing effects on banks' profits. First, banks do not earn revenues from ATM transactions. Second, banks can increase account fees as competition between them is weakened by the use of interchange fees.

Considering banks with equal network sizes, we show that the formation of a coalition benefits banks if the interchange fee is high enough. In the case of banks choosing jointly the interchange this always the case. Concerning welfare, agreements between banks to ban ATM usage fees may be detrimental for consumer welfare. The impact on total welfare is positive. When banks operate ATM networks of different sizes, it turns out that banks with a smaller network have a stronger incentive to enter coalitions. It also emerges that the presence of ATM coalitions is more likely in markets where banks have more similar network sizes. When banks can invest in their networks, we find that there is more investment in the case of a coalition provided interchange fees are high enough.

The present model abstracts from some issues. We focus on a duopoly model, however, empirical studies, for instance Hannan (2007), show that market structure and pricing structure is linked. To complement these empirical results it would be interesting to extend existing theoretical models to allow for an endogenous number of banks in different pricing regimes. Another issue that has received less attention in the literature is the entry of independent service operators (ISO) who operate ATM networks but do not offer other bank services. The extent of ISO varies among countries. For example in the UK and Australia, the number of ATMs provided by these operators increased hugely in numbers. Subsequent research could study how the the structure of ATM pricing affects entry of ISOs.

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