The effects of regulating interchange fees at cost on the ATM market

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Abstract

We show that regulating interchange fees at cost reduces banks' incentives to deploy free ATMs over time. Simultaneously, more and more charging ATMs are deployed by independent deployers. These results are consistent with the recent evolution of the British ATM market.

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Recently, the use of interchange fees in payment systems has been questioned by competition authorities. In some countries, public authorities have required interchange fees to be set to reflect costs. An interesting example can be found in the British ATM market. The Cruickshank (2000) Review, an independent investigation on competition in the banking industry, expressed concerns over several points. First, entry was not free on the ATM market: only card issuers could deploy ATMs. Second, the wholesale pricing of transactions reflected more the bargaining power of banks than pure cost considerations: large issuers were receiving higher interchange fees on shared transactions than small issuers.[1] Third, the retail pricing involved large markups over costs: larger issuers were charging "foreign fees" to their cardholders on shared transactions as high as 5 or 6 times the level of the interchange fee.

Following the publication of the review, LINK, the operator of the British shared ATM network, made two decisions: it opened up membership to non-card issuers, therefore permitting independent ATM deployers (hereafter IADs) to enter the market. It also made the multilateral interchange fee cost-based and annually reviewed.[2] By the end of 2000, banks also dropped the existing foreign fees.

The new LINK policy has had several consequences on ATM deployment: by mid 2000, interchange fees decreased from 28 pence to 20 pence for a branch machine and from 40 pence to 30 pence for a non-branch machine. From the same year, IADs entered the market and began to deploy pay-to-use machines. Table 1 shows a rapid growth of surcharging ATMs between 2000 and 2006. During the same time the deployment of free ATMs slowed. Most of the new fee-charging machines have been installed in locations where there did not exist any ATM previously. But some banks have also sold some of their non-branch machines to independent deployers: in 2004, the bank HBOS sold 816 non-branch machines to the IAD Cardpoint. The Treasury Committee of the House of Commons (2005) notes "If others follow suit, there could be conversion of a large number of free ATMs to charging and significantly lower access to free cash withdrawals for many consumers."

[1] In ATM markets, the interchange fee is paid by the card issuer to the ATM owner on shared transactions.

[2] The interchange fee is calculated by dividing the total annual cost of deploying and running the network by the total number of withdrawals processed (House of Commons, Treasury Committee (2005)).

#ATMs	2000	2001	2002	2003	2004	2005	2006
Free	28	29	32	32	33	33	35
Pay to use	4	7	10	15	22	25	26
Total	33	36	42	48	55	58	61

Table 1 : ATM deployment in the UK, in thousands (source: LINK).

In this paper, we examine the effects of regulating the interchange fee at cost on ATM deployment. The predictions of the model fit the empirical evidence: we show that this regulation makes the interchange fee decrease over time, which in turn reduces banks' incentives to deploy ATMs. IADs, if present, deploy more and more charging ATMs.

1 The model with banks

1.1 The model and the equilibrium

b banks provide access to a shared ATM network. As in the UK, banks do not levy fees for ATM usage. In this case ATMs are identical for customers and ATM deployment does not influence banks' deposit market shares: the number of cardholders of bank i is fixed to D_i.[3] The total mass of cardholders is normalized to one. Each cardholder makes w withdrawals. The number of ATMs deployed by bank i is n_i and the total number of ATMs is n. We assume that each bank deploys its ATMs uniformly in the shopping space and that each cardholder allocates his withdrawals according to the ATM market shares: he makes wn_i/n withdrawals at bank i's ATMs. The cost of deploying and operating an ATM is denoted by c.[4] When a cardholder of bank i makes a withdrawal at an ATM of bank j, bank i pays an interchange fee, a, to bank j.

The profit of bank i associated with ATMs is

$$\pi_i = a(1 - D_i)\frac{n_i}{n}w - aD_i\frac{n - n_i}{n}w - cn_i$$

[3] Donze and Dubec (2006) and (2009) study models with endogenous deposit market sizes.

[4] This cost is annual and includes depreciation, installation, site rental, maintenance, communication costs, cash replenishment, and the opportunity cost of the cash in the machine.

The first term corresponds to the interchange inflows received by i. The second term corresponds to the interchange outflows paid by i. The third term corresponds to the deployment costs. We look for the Nash equilibrium of the game. Bank i maximizes its profit with respect to n_i. The first order condition is

$$a(1-D_i)(1-\frac{n_i}{n})\frac{w}{n}+aD_i(1-\frac{n_i}{n})\frac{w}{n}-c=0$$

The term w/n is the number of withdrawals per ATM. There are two positive effects for bank i when it deploys an extra ATM. There are new withdrawals from non-customers who were using other banks' machines. Interchange inflows increase by $a(1-D_i)(1-n_i/n)(w/n)$. There are also new withdrawals from own-customers who were using other banks' machines. Bank i's interchange outflows diminish by $aD_i(1-n_i/n)(w/n)$. Summing the b FOC over i, we obtain the total network size:

$$n^*(a)=\frac{b-1}{b}\times\frac{aw}{c}$$

and $n_i^*(a)=n^*(a)/b$ for $i=1,...b$.

Clearly a higher interchange fee makes banks deploy more ATMs as the competition to process withdrawals is strengthened. Note that - and this is a key point - at equilibrium, the sum of the interchange inflows over banks is equal to the total cost of the network for any interchange fee:

$$\sum_i a(1-D_i)\frac{n_i^*(a)}{n^*(a)}w=a\frac{b-1}{b}w=cn^*(a)$$

One should not be surprised by this result. It comes from the fact that at equilibrium, the average interchange inflow per ATM, $a(1-1/b)(w/n^*)$ is equal to the marginal revenue of any bank i, $a(1-D_i)(1-1/b)(w/n^*)+aD_i(1-1/b)(w/n^*)$ which is also equal to the marginal cost, c.

1.2 Effects of the British regulation scheme

Let us denote by $t=1,2,...$, the dates at which the interchange fee is changed. The interchange fee at date t is a_t. We take a_1 as exogenously fixed. The interchange fee at date $t+1$ is obtained by dividing the total network cost in t by the total number of withdrawals:[5]

$$a_{t+1} \equiv \frac{cn^*(a_t)}{w} = \frac{b-1}{b} a_t$$

Proposition 1 *Regulating the interchange fee at cost makes the interchange fee decrease over time, which lowers banks incentives to deploy ATMs.*

We have noted that for any interchange fee, the sum over banks of interchange inflows is equal to the total cost of the network. However interchange inflows are only generated by foreign withdrawals. By dividing the network cost by the *total* number of withdrawals, the regulator induces a new interchange fee that is below the previous break-even level. Consequently banks reduce the size of their ATM networks which makes the number of withdrawals per machine rise. In turn, this induces a lower average cost per withdrawal, which drives the interchange fee downward at the subsequent regulatory review, and so on.

The prediction that the number of ATMs converges to zero is probably too extreme. Indeed, branch machines are not only deployed to generate interchange revenues but also to replace more costly human tellers. Hence, while banks should keep most of their branch machines, regulating interchange fees at cost seriously threatens the existence of non-branch machines.

2 Introduction of independent ATM deployers

There are now b banks and d independent ATM deployers (IADs). IADs do not have cardholders and just deploy ATMs. The deployment is uniform in the shopping space. The number of ATMs deployed by IAD i is $\widetilde{n}_i$. We let $\widetilde{n} = \sum_{i=1}^{i=d} \widetilde{n}_i$. The total network size is $n + \widetilde{n}$. As before, withdrawing cash at an ATM operated by a bank is free. We assume that the number of withdrawals made at ATMs of bank i is $(n_i/(n + \widetilde{n}))w$. Withdrawing cash at an IAD ATM is not free: users pay a fee s_j per withdrawal made at an ATM of IAD j. The number of withdrawals made at ATMs of IAD j is $\lambda(s_j)(\widetilde{n}_j/(n + \widetilde{n}))w$ where $\lambda(s_j)$ is a decreasing function of s_j

[5] Banks do not know the precise length of time between two dates at which the interchange fee is changed so that they act as price takers regarding the interchange fee: in their deployment choice, they do not consider the effect of changing n_t on $a_{t+1}, a_{t+2}, \dots$ etc.

satisfying $0 < \lambda(s_j) \leq 1$. As withdrawing cash is more costly using an IAD ATM, we assume that if bank i and IAD j have the same number of machines, there will be $1/\lambda(s_j)$ times more withdrawals at i's ATMs than at j's ATMs. We also assume that $\arg\max_s \lambda(s)s$ is unique and equal to s^*. Furthermore $\lambda(s^*)s^* \geq \lambda(0)a_1$.[6]

The cost of deploying and running an ATM is c for a bank. We take into account cost differences between banks and IADs when deploying ATMs:[7] the cost of deploying and running an ATM is μc for an IAD with μ satisfying $0 < \mu \leq 1$. The profit of bank i is

$$\pi_i = a(1 - D_i)\frac{n_i}{n + \widetilde{n}}w - aD_i\frac{n + \widetilde{n} - n_i}{n + \widetilde{n}}w - cn_i$$

The profit of the independent deployer j is

$$\widetilde{\pi}_j = \lambda(s_j)s_j\frac{\widetilde{n}_j}{n + \widetilde{n}}w - \mu c\widetilde{n}_j$$

At equilibrium, IAD j chooses $s_j^* = s^*$ previously defined. We let

$$\alpha(a) = \frac{\mu}{\lambda(s^*)}\frac{a}{s^*}$$

An $\alpha(a)$ larger than 1 means that banks have a comparative advantage over IADs when deploying ATMs. We describe the equilibrium number of ATMs.

- If $\alpha(a) \geq 1/(1 - \frac{1}{b})$ network sizes are

$$n^*(a) + \widetilde{n}^*(a) = \frac{b-1}{b} \times \frac{aw}{c}; n^*(a) > 0; \widetilde{n}^*(a) = 0$$

- If $\alpha(a) \in \left[1 - \frac{1}{d}, 1/(1 - \frac{1}{b})\right]$ we have

$$\begin{cases} n^*(a) + \widetilde{n}^*(a) = \dfrac{b + d - 1}{b + \alpha(a)d} \times \dfrac{aw}{c} \\[2em] \dfrac{n^*(a)}{n^*(a) + \widetilde{n}^*(a)} = \dfrac{b + (\alpha(a) - 1)bd}{b + \alpha(a)d} \\[2em] \dfrac{\widetilde{n}^*(a)}{n^*(a) + \widetilde{n}^*(a)} = \dfrac{\alpha(a)d - (\alpha(a) - 1)bd}{b + \alpha(a)d} \end{cases}$$

[6]In the UK, the IADs can choose to receive either the interchange fee a or a usage fee s for each withdrawal processed. The inequality $\lambda(s^*)s^* \geq \lambda(0)a_1$ makes IADs prefer the usage fees.

[7]According to Link, the typical cost of operating a free cash machine is £19,000 per year at a branch, and £33,000 at other locations for a bank The cost is £9500 for an IAD (House of Commons, Treasury Committee. 2005).

For this set of parameters, one can verify that $(n^* + \widetilde{n}^*)(a)$ and $n^*(a)$ are increasing in a while $\widetilde{n}^*(a)$ is decreasing.

- If $\alpha(a) \leq 1 - \frac{1}{d}$, network sizes are

$$n^*(a) + \widetilde{n}^*(a) = \frac{d-1}{d} \times \frac{\lambda(s^*)s^*w}{\mu c}; n^*(a) = 0; \widetilde{n}^*(a) > 0$$

To study the effect of the British regulation scheme, let us assume that initially $\alpha(a_1) \geq 1/(1-1/b)$: only banks deploy ATMs. At first the interchange fee decreases according to the rule

$$a_{t+1} = \frac{b-1}{b} \times a_t$$

Banks gradually reduce the size of their ATM fleets. Once $\alpha(a_t)$ becomes smaller than $1/(1-1/b)$, the interchange fee keeps decreasing according to the rule

$$a_{t+1} = \frac{cn^*(a_t)}{wn^*(a_t)/(n^*(a_t) + \widetilde{n}^*(a_t))} = \frac{c(n^*(a_t) + \widetilde{n}^*(a_t))}{w} = \frac{b+d-1}{b+\alpha(a_t)d} \times a_t$$

which is strictly smaller than a_t. Simultaneously, IADs deploy more and more ATMs while banks withdraw their machines. Once $\alpha(a_t)$ becomes smaller than $1 - 1/d$, the interchange fee becomes constant and a stationary state is reached. Only IADs deploy ATMs. We sum up the results in the following proposition:

Proposition 2 *When d independent ATM deployers are present on the market, regulating the interchange fee at cost reduces the level the interchange fee gradually. As a consequence, the number of free machines deployed by banks decreases while the number of pay-to-use machines deployed by IADs increases.*

As the interchange fee decreases, the comparative advantage of IADs over banks $\alpha(a)$ increases, which makes IADs deploy more and more machines. Here again in the real world, banks should keep most of their branch machines to save costs on human tellers, and IADs should operate most of the non-branch machines.

3 Conclusion

In 2005, the British Treasury Committee noted that "the mechanism by which the interchange fee is calculated may give banks an incentive to pursue efficiency savings by reducing the availability of free cash machines in low footfall areas". We have constructed a model that shows that setting ATM interchange fees at cost leads to decreasing incentives of deploying free ATMs. The model could explain a part of the evolution of the ATM market in the United Kingdom since 2000. Interestingly since the end of 2006, the LINK network has set a premium of up to 50% percent per interchange fee when withdrawals are made at sites with low volume or located in poor areas. This seems to confirm the presumption that the regulating scheme was too stringent to maintain free non-branch machines.

References

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