# THE CHOICE BETWEEN MAIL AND DIGITAL IN THE PROVISION OF FINANCIAL SERVICES: A DOUBLE HOTELLING APPROACH

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## 1. Introduction

Historically financial institutions have been large mail users as they provided financial information and paper statements to their customers, but in more recent times their customers have been offered the choice of alternative services through the digital medium on-line. The customers of these institutions not only have a choice of bank, but also a choice in the kind of service they receive within the transactional market. In recent years we have observed a significant switching from transactional mail to the digital alternative. These market developments are important for policy makers to understand as they seek to maintain the financial viability of the Universal Service Provider (USP).

In De Donder et al. (2012a), we looked at the welfare and pricing impacts for the USP and use of transactional mail in the presence of a digital alternative and charges to customers for mail and digital services. We considered the case where a social planner sets the producer and customer prices (other than those assumed to be constant) to maximize welfare. We also considered the case where the banks profit maximize in setting their customer prices in the transactional market with the social planner then setting other prices for postal products to maximize welfare. Finally we introduced a cap on the single piece price, with the USP's financial viability threatened by the digital competition to transactional mail. The results and analysis brought to the fore the consideration of public policy and the balance of choices between the customer demand for the universal service and associated fixed costs of the USP, the incentives and profit maximizing behaviour of the banks and the customer demand for and development of the alternative electronic medium.

In this paper, we look more closely at the customer behaviour in the transactional market and factors that influence the choice of services. In particular, we look at the choice between two financial services distinguished by paper and digital statements within a model à la Hotelling (Hotelling 1929). Two horizontally differentiated banks compete to attract customers by offering, among other things, two horizontally differentiated transactional media: paper statements and a digital alternative. Customers differ according to their intrinsic preferences for one bank versus the other one (for reasons assumed to be exogenous) and for one transactional medium versus the other one. We assume that the two dimensions of preferences are independently and uniformly distributed in the population. We focus on the pricing by banks of transactional media, so that we concentrate on how banks attract (or retain) customers by pricing the two transactional media in order to maximize their profit. We examine how the demand for paper statements by banks' customers is affected by, among others, the price of mail as set by the USP to the banks and marginal transaction costs.

In Section 2 we summarise the framework of the double Hotelling model. In Section 3 we show how this model informs us of how price and non-price factors affect demand for paper and digital services, with the mail price included as a marginal cost to the banks in the provision of the paper statement services. We explore how profit maximisation of the banks leads to the full pass through of any mail price to customers, as well as factors that affect the impact on the demands for the two services. Within this framework we then extend the analysis to consider the scenario where banks do not directly charge for paper or digital services in Section 4. We consider how the banks' approach to charging for its paper and digital statements can affect the demand for those services and, further, how mail price changes can affect their respective demand. In Section 5 we conclude

that this framework brings greater clarity as to the role of mail price as an input cost to one medium in the presence of a digital alternative within the transactional market, and its effect on demand.

## 2. Model framework

We here set out the salient features of the model. The full model is set out in detail in De Donder et al (2012b).

There are two banks (A and B) and each bank offers the choice of services with digital statements (good 1) and paper substitute (good 2). Both banks and both products within any bank are considered as horizontally differentiated by customers. Even if both products were similarly priced by a bank, some customers from that bank would prefer paper statements while other would prefer the electronic substitute. Similarly, even with prices equal across banks, some customers would prefer bank A while other would prefer bank B.

Both transactional media are located on a [0,1] segment, denoted by Z, with the digital medium at zero and paper statements are one. Each final consumer has a preference for both goods that is characterized by his location $z$ on Z. That is, an individual located at $z$ incurs a disutility of $z$ (the distance between his most preferred variant of the good and the characteristic of good 1) times a 'transportation cost' r when consuming good 1, and a disutility of (1 - $z$) times r when consuming good 2.

Similarly, banks are located on another [0,1] segment, denoted by X, with bank A at zero and bank B at one. Each individual has a location $x$ on Xthat represents his preferences for the two banks. This preference is a function of all characteristics of the banks, which are assumed exogenous. An individual located at $x$ incurs a disutility of $x$ (the distance between his most preferred variant of the bank and the characteristics of bank A) times a 'transport cost' $t$ when opening an account with bank A, and a disutility of (1 - $x$) times t when opening an account with bank B.

We assume for simplicity that the two dimensions of preferences are orthogonal to each other, and thata continuum of mass one of customers are uniformly and independently distributed on the Z * X = [0,1]*[0,1] space. Alternative distributions could be applied, but we concentrate on the uniform distribution because of its simplicity.

Within this framework we can look at the profit maximising outcome of the banks. We assume that the banks first simultaneously set their prices in order to maximise their profit, with final customers then observing the prices in both banks and choosing which bank to patronise, and what type of alternative medium to buy in this bank. We solve this game and provide its Nash equilibrium in the next section.

## 3. Price effect and market share results with banks charges

We start by solving for the customers' decisions for given price levels. The customer price of good $i$ ($i$ = 1, 2) in bank $j$ ($j$ = A, B) is denoted by $q_{ij}$. Customers obtain a gross utility level of $U_{ij}$ when they consume one unit of good $i$ in bank $j$. To obtain the net utility level, one has to subtract from this gross utility both the price of the good bought and the disutility incurred from consuming a good whose characteristics generically differ from the most-preferred one, in a bank whose characteristics also differ from the individually optimal ones. Customers have to choose one (and only one) bank, and one (and only one) transactional medium in that bank. They do this by comparing the net utility levels they obtain in each bank with each transactional medium.

Intuitively, consumers with a low value of x prefer bank A to bank B, while consumers with a large value of z prefer paper statements to the digital alternative. We establish in De Donder et al (2012b)

that there exist threshold levels of both x and z that determine the choice of consumers. Although our results do not depend on the specific sequence of choices by customers, it is easier to illustrate them by assuming that they choose first their bank, and then the transactional medium they prefer. A customer choosingbank j (A or B) will then prefer paper statements to electronic medium provided that his preference for the former (measured by z) is larger than the following threshold:

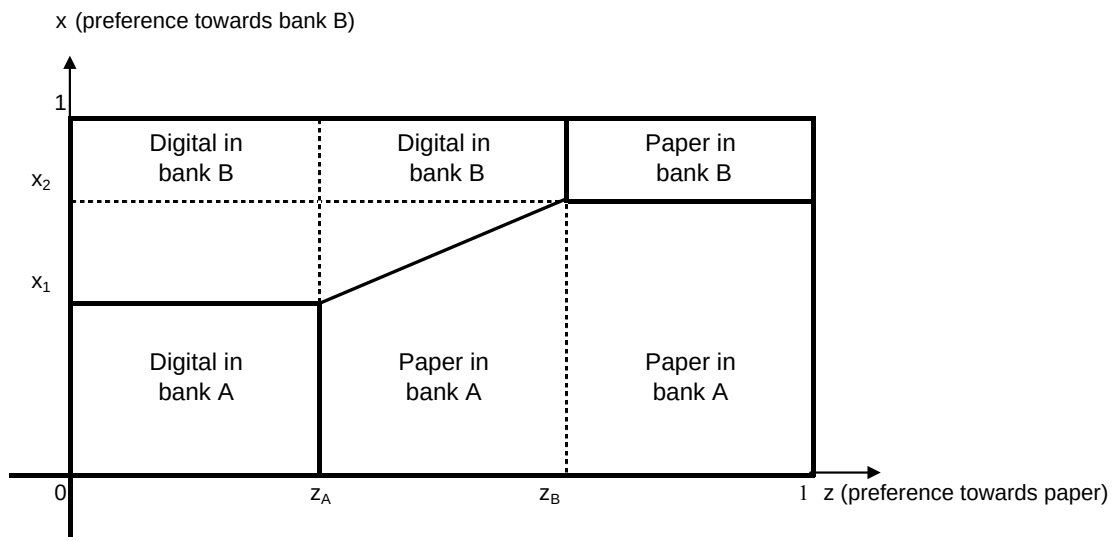
$z_A = 0.5 + \left[\left(\left(U_{1A} - q_{1A}\right) - \left(U_{2A} - q_{2A}\right)\right)/2r\right]$ in bank A

and $z_B = 0.5 + \left[\left(\left(U_{1B} - q_{1B}\right) - \left(U_{2B} - q_{2B}\right)\right)/2r\right]$ in bank B.

Assume for instance that paper statements are a better deal (because of a lower price for instance) in bank A than in bank B. We then obtain that $z_A < z_B$. Anticipating their transactional medium choice, the consumer then decides to patronise bank A provided that his preference for this bank (measured by x) is lower than some threshold. If $z < z_A < z_B$, the consumer anticipates that he will buy the electronic substitutes in both banks, and he joins bank A if his value of x is lower than the threshold $x_1 = 0.5 + \left[\left(\left(U_{1A} - q_{1A}\right) - \left(U_{1B} - q_{1B}\right)\right)/2t\right]$. If $z > z_B$, the consumer anticipates that he would buy paper statements in both banks, and chooses bank A provided that his preference x is lower than $x_2 = 0.5 + \left[\left(\left(U_{2A} - q_{2A}\right) - \left(U_{2B} - q_{2B}\right)\right)/2t\right]$. Finally, for intermediate preference for paper statements ($z_A < z < z_B$), the consumer chooses paper statements in bank A and the digital alternative in bank B.

The choices made by customers between the two banks and two goods can be represented in a 2x2 diagram with the choice between goods on the horizontal axis (Z) and choice of bank on the vertical axis (X), and both axes range from 0 to 1 indicate the proportioning of customers choosing between the banks and goods. If the paper statements are relatively more attractive in banks A than in bank B (ie. $z_A < z_B$) the customers' preferences are as represented in Figure 1[1].

**Figure 1: Choice of banks and of medium when** $z_A < z_B$




[1] If $z_A > z_B$ the diagonal slope in Figure 1 would be in the opposite direction.

We then have that as $z_A$ or $z_B$ increases the market share and demand for paper statement reduces. For both banks the value of $z_j$ increases directly proportionate to increases in the price of paper statements (good 2) or decreases in the price of digital (good 1). These represent own and cross price effects.

In addition, for both banks the value of $z_j$ increases directly proportionate to the reduction in the utility of preference for paper statements (good2) or increases in the utility of preference of digital (good 1). These represent the non-price effects.

The scale of both price and non-price effects depend inversely on $r$, the marginal 'transport cost' of the change, and are therefore less strong when these marginal 'transport costs' $r$ are high. Conversely, at a lower $r$ the competition between the two goods intensifies (because they are seen as more and more alike by customers).

We implicitly assume that there exists a price difference between the services with paper and digital statements such that customers would switch to digital if they were sufficiently cheaper than paper. Individuals who have no internet access would be located at or very close to one extreme where customers with paper statements are located. These are the individuals that require the largest difference in prices between the services with paper and digital statements to switch to the latter. How different the prices have to be for them to switch depends on the value of the parameter $r$.

We now solve the profit-maximising choice of prices by both banks, when they are symmetrical both in terms of preferences ($U_{ij} = U_i$ for $j = A, B$) and in the marginal costs $c_{ij}$ of providing product i in bank j (so that $c_{ij} = c_i$ for $j = A, B$). We show in De Donder et al (2012b) that there exists a unique symmetrical Nash equilibrium where $q_1 = c_1 + t$ and $q_2 = c_2 + t$. In words, the equilibrium price for both goods in both banks equals its marginal cost plus a mark-up that is proportional to the transaction cost on the firm dimension. Since this transportation cost can be viewed as a measure of the degree of competition between banks (a lower value of t meaning a more competitive industry), we then obtain that the mark-up over marginal cost is inversely proportional to the intensity of competition between banks.

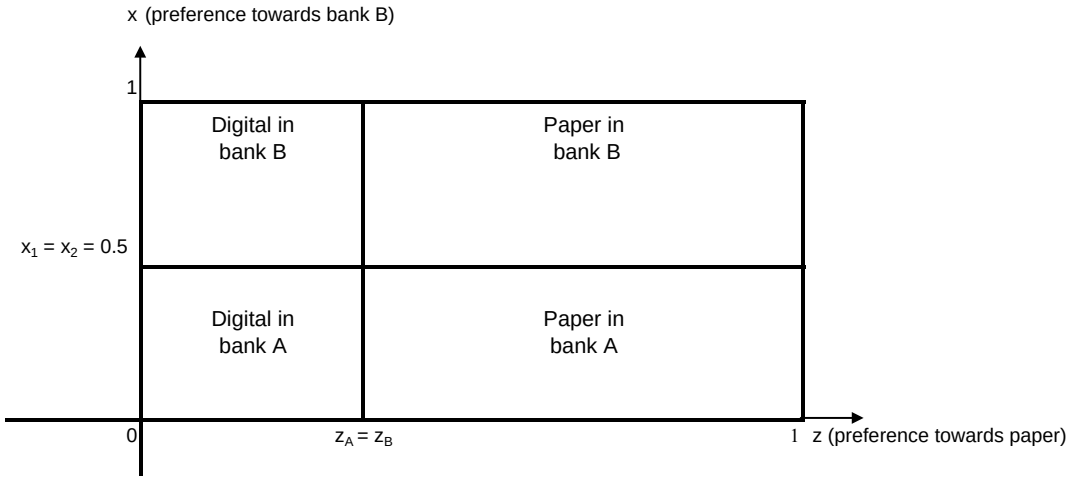
At equilibrium, we then have $z_A = z_B$ so that Figure 1 would change as shown in Figure 2 with $z_A = z_B$ and the vertical axis is divided equally between the two banks.

If we further assume that the marginal cost of paper statements is the sum of the marginal cost for the digital medium, of the mail price p and the preparation cost k, we obtain that

$$q_1 = c_1 + t \qquad \text{and} \qquad q_2 = c_1 + p + k + t$$

so that the equilibrium price of paper statements exceeds the price of the electronic substitute by exactly the difference in marginal costs, p+k.

**Figure 2: Choice of banks and of medium when equi-symmetric**




As an example, if $U_{1j} = U_{2j}, k = 0, p = 0.20, c_1 = 0.30, t = 0.40$ and $r = 0.40$, then the Nash equilibrium where banks have equal utilities and costs (i.e. equi-symmetric), the market price for digital (good 1) is 0.70 and for paper (good 2) is 0.90, Furthermore, the market share for good 1 is $z_i = 0.75$ and for good 2 is $1 - z_j = 0.25$ (where $j = A$ or $B$).

Further, if the value of $r$ reduces from 0.40 to 0.30, then the market prices are the same but market share for the service with digital statements is $z_A = 0.83$ and for the service with paper statements is 0.17. This would reflect digital and paper statements becoming closer substitutes such that there is a move towards the lower priced service of digital statements.

Alternatively, if we only changed the mail price from 0.20 to 0.30, then the market price for the service with paper statement (good 2) increases from 0.90 to 1.00 and the market share for the service with digital statements is $z_1 = 0.88$ and for the service with paper statements is 0.12. The increase in the mail price is fully passed through to the customers of the services with paper statements and leads to a reduction in demand for those services as some customers switch to the digital alternative.

## 4. Further results with and without bank charges

At present in the transactional market we do not typically observe direct charges for bank paper statements. We can obtain this result within our model framework by introducing an additional term $s_2$ for the profit made on each customer from its paper statements, beyond the direct service of the statement – for example coming from advertisements with the statements. The introduction of $s_2$ acts as a negative marginal cost and has the effect of decreasing the market price $q_2$ banks charge for the paper statements such that its marginal cost is $c_2 = c_1 + p + k - s_2$. There then exists a value of $s_2$ that would lead to the price $q_2$ banks charge for statements being zero.

In a similar way we may consider the profit made on each customer from services with digital statements as $s_1$. Then, there would exist a value of $s_1$ that would lead to a zero market price $q_1$ for the service with digital statement. Further if the marginal cost for digital statement is lower than that for paper statements this value of $s_1$ would be lower than the value of $s_2$ needed for the

market price of the paper statements to be zero. We note that $s_1$ and $s_2$ affect the absolute level of the market prices. However, they do not change the result that any increase in the mail price p is passed through in totality to customers. The previous result of the full pass through of the mail price within the marginal costs of good 2, in this symmetric case, remains unaffected by the introduction of the $s_1$ and $s_2$ terms.

If banks make money on customers beyond the selling of statements (such that $s_1, s_2 > 0$) this decreases banks' costs of providing transactional media, and the model tells us that the market equilibrium price of such media decreases by the full amount of this profit per customer. If the unit profit is the same for both transactional goods, the decrease in prices is the same for both goods. If somehow the unit profit is larger for paper statement users, then the price of paper statements decreases more than the price of digital.

In the context of understanding the potential market share and demand effect of a change in the mail price p for the banking service associated with mail (i.e. paper statements), we can make a further observation from this and in the context of the interest rate paid by the banks to their customers on the digital and paper statement accounts. An increase in p leads to a reduction in the market share of the service with paper statements, but the degree to which it does may depend on the charging policy of the banks.

We can consider two independent scenarios: one where the banks have a positive charge for the services with paper statement $q_2 > 0$ and one where it is negative $q_2 < 0$. While a change to p could move the position from one scenario to the other (from $q_2 > 0$ to $q_2 < 0$), our focus is more that the banks could move from one to the other through a change to its charging policy and, furthermore, when $q_2 < 0$, the effect of a mail price change on volume could be less than the same price changed in an environment when $q_2 > 0$.

When $q_2 < 0$, we have the possibility of a negative price being charged to the customers of services with paper statements which could be represented by a zero price for the paper statements and a reduction in the interest payment to customers (akin to a negative value of $s_2$ above). An increase in mail price could then lead to retention of the zero price for the services with paper statements and a reduction in the interest payment to customers for the services with paper statement. We note that the effect of the mail price on demand is indirect or implicit as it is through the interest payment.When $q_2 > 0$ we have a direct or explicit charge for the paper statement such that the mail price change has a direct effect on market share.

The symmetric equilibrium described above would apply in both scenarios (either when $q_i < 0$, or when $q_i > 0$) and the same variable relationships apply in both. Hence, for example, the value of r again affects the market share of the service with paper statements. If the value of r is the same whether $q_2 = 0$ with a low interest payment or $q_2 > 0$ with a higher interest payment, *ceteris paribus* there would be the same market share for the service with paper statements for the two scenarios. However, if the value of $r$ differs as to whether $q_2 = 0$ with a low interest payment or $q_2 > 0$ with a higher interest payment, the market share of the service with paper statements would not be the same between the two scenarios. The $r$ value could be different, and reduce in value, between the two scenarios if customers' preferences change with a move between indirect and direct charging environment by the banks, such that the two services are seen to be closer substitutes were the banks to directly charge for the statement services. This would then affect both the market share and responsiveness of demand to price changes.

Hence, if the banking environment changed from one scenario, we might observe (i) a step change in market share and (ii) a step change in the price elasticity with respect to $p$. While we cannot conclude on the magnitude of the change in r that could occur with a change in scenario, it is possible for there to be both a step loss in market share for the mail industry and an enhanced loss of market share if the mail price increased, dependent on the relative values of $r$ between the two scenarios. A change in banking charging may then lead to a step change in both the market share and price elasticity of the banking service that uses the mail medium.

## 5. Conclusions

We have discussed a Hotelling model framework in two dimensions with two banks each selling two services with digital and paper statements respectively. We show that when banks profit maximise the market price for the service with paper statements includes a mark up on marginal cost to reflect 'marginal transport or transaction costs' for customers and there is a full pass through of any mail price to their customers in the symmetric case. We can use this model to show how customer utilities from the two goods and marginal costs including the price of mail affect the demand for the services of paper and digital statements, and hence how developments in preferences for digital banking services and increases in mail prices can both lead to a reduction in mail demand. We have also described how, if the banking environment were to change its charging policy from one that implicitly charges customers the mail price to one that explicitly charges the mail price, this could lead to a step change in both the demand for services with paper statements and the demand elasticity with respect to the mail price. Other exogenous changes which move customer perceptions and preference could potentially have similar effects.

We then have the potential for the price elasticity of demand for mail services to remain fairly stable for those remaining with the paper statements while the current market environment continues. Even so, mail volumes may continue to fall as customers preferences change. However, if that market environment changes, for example through financial institutions changing the way in which they recover mail charges from their customers, this could have a significant impact on the mail service, both in terms of a shift in mail demand and greater sensitivity to further mail price increases.

Hence, we provide an economic rationale and framework for considering changes in demand and price elasticities for mail in a banking sector that could be extended to other sectors serviced by mail and digital media. This framework brings greater clarity as to the role of mail price as an input cost to one medium in the presence of a digital alternative within the transactional market, and its effect on demand. Further extensions of the model could consider alternative conditions that could affect the degree to which a mail price changes affects demand. It therefore provides an economic framework for postal mail demand, for further investigation within economics, econometrics and customer market analysis.

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