

MERIT-Infonomics Research Memorandum series

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2004-020



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Alle Giro's Werden Brüder? Harmonizing Europe's network standards

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October 25, 2004

Abstract

The attractiveness of adopting a common network standard depends on the underlying transaction patterns. A model is introduced to analyze the effect transactions patterns on the compatibility decision by 2 firms in different countries. If only a small share of all transactions is cross-border, firms have strong incentives to maintain incompatible standards across countries. The model is applied to the case of harmonizing Europe's payment networks.

JEL classification: F36, G21, L14, L89

Key words: Network Externalities, Transaction Patterns, Banks, Cross-border Competition

1 Introduction

Aligning Europe's many national standards and networks is an important challenge in the quest for a common market. Credit transfer payment systems, for example, are still national: in spite of the common currency it is much easier to transfer money from Lille to Marseille (1000 km) than across the Belgian border to Kortrijk (30 km).¹

*This paper resulted from a discussion at the 23rd SUERF symposium in Brussels. Comments and suggestions by Arnout Boot, Robin Cowan, Martin Fase, Leo van Hove, and Steven Ongena are gratefully acknowledged.

¹Credit transfers comprise payments where a client instructs his bank to transfer money to the account of someone else, not necessarily with the same bank. The category includes direct debits, where the payee (generally a company, for example an electrical utility) instructs his bank to take the money out of the account of the payor.

This lack of European standardization is important because it hinders intra-European commerce. It is also a barrier against cross-border entry of banks. A bank in country *A* cannot offer retail products in country *B* without having some form of access to the payment system in that country: its customers will need access to their savings accounts and they will want to transfer money from their salary accounts to pay their bills. Such access generally requires a (substantial) local presence with set-up costs, etc.

This (lack of) cross-border entry is an important issue. Hoschka (1993) provides a theoretical model to analyze the effect on cross-border entry on the domestic deposit market, and finds that cross-border entry can (1) increase price competition, (2) reduce X-inefficiencies, (3) spoil collusive domestic equilibria, and (4) increase the quality and variety of services.

Berger, DeYoung, et al. (2000) survey the empirical literature on bank efficiency, and find (1) a substantial dispersion among efficiencies (X-inefficiencies) both within and across countries, (2) a clear reduction of X-inefficiencies in a country after the entry of foreign competitors.²

In short, there is both theoretical and empirical evidence that cross-border entry in Europe could greatly enhance welfare. Cecchini (1988) quantifies the yearly benefits of full competition among European financial service providers at 22 billion ECU.³ Yet sixteen years, and many common market initiatives, later European retail banking markets remain stubbornly local.⁴ It is therefore interesting to further explore the decision by banks to adopt a common (international) standard.

This paper models payment systems as economic networks and reformulates the international harmonization of domestic standards as a compatibility issue. It introduces a model to analyze the compatibility decision in a 2-country setting. The model explicitly considers transaction patterns. In practice, these patterns are highly national. Less than 1% of all credit transfer payments and about 5% of all card and cash payments are cross-border, the rest is domestic. As the overview in table 1 shows, the same is true for other networks like mail and telephony. The analysis and model in this paper can therefore be equally applied

²Berger, De Young, et al. talk of X-efficiencies, while Hoschka prefers X-inefficiencies. This paper uses the latter term.

³About 30 billion Euro in today's money. This figure is derived by assuming that for each financial product (loans, mortgages, savings, etc.) prices in all European countries would migrate to those in the country with the best prices (lowest interest rates for loans and mortgages, highest for savings).

⁴Kleimeier and Sandor (2003), for example, examine retail deposit and lending rates in 10 European countries, and conclude that the European market for retail banking products remains fragmented.

Category	Int'l traffic	Countries included
Surface mail	1.5%	Global average
Telephony		
- Fixed line	1- 1.5%	US
- GSM	1.5-2%	Scandinavia
Payments		
- Credit transfers	0.5%	EU, US, Canada, Japan
- Credit/Debit cards	5%	EU
- Cash	5%	Euro zone

Table 1: Cross-border traffic as a percentage of all traffic (number of letters, call minutes and number of payment transactions)

Source: mail data from UPU (2004), fixed telephony data from FCC (2003), Telestatistik (2000) and TeliaSonera (2003), GSM data from Telestatistik (2000), transfer payment data from BIS (2004) and ECB (2003), card payment data based on McKinsey analysis of Visa and MasterCard data, cash estimate based on Euronote diffusion figures (analysis available from the author).

to other network sectors like telecommunication.

The main result of the model is that transaction patterns crucially affect the compatibility decision. With random patterns, firms always prefer compatible standards. This result changes radically if transaction patterns are semi-autarkic. Firms will then generally prefer incompatibility.

This paper proceeds as follows. Section 2 analyzes the literature on transaction patterns and network effects. Section 3 introduces a model to analyze the effect of transaction patterns on the harmonization of sponsored standards. Section 4 applies the model to the (lack of) harmonization of European systems for making credit transfer payments. Section 5 discusses the results.

2 Literature

There is ample evidence that standards and in particular payment systems are subject to increasing returns, where each user makes the standard or network more valuable to other (potential) users.⁵ Empirical studies confirm the existence of network externalities for ATMs (Saloner and Shepard, 1995, and Sharma, 1993), ACH-transfers (Gowrisankaran and Stavins, 2002), and debit and credit cards (Stavins, 2001, and Man-

⁵For a recent overview of the topic, see the June 2003 issue of the Review of Network Economics, which was entirely dedicated to network effects in payment systems.

tel and McHugh, 2001).

A wide body of literature analyzes the adoption and compatibility of such network technologies. The literature generally distinguishes sponsored standards, which can be owned and controlled by firms (e.g. video formats like VHS and Betamax), and unsponsored standards, which are open to all (e.g. the fax protocol). Payment system standards are generally sponsored, hence the remainder of this section will focus on the sponsored standards literature.⁶ Furthermore, payment systems are mostly adopted by firms (banks) that compete monopolistically by offering differentiated products. The compatibility in this context (differentiated goods subject to sponsored network standards) has been analyzed by Matutes and Regibeau (1988). Their ‘Mix & Match’ model examines the compatibility decision by 2 firms that offer differentiated network goods. They find that in equilibrium firms prefer compatibility. Shy (2001) models the compatibility decision by firms whose customers face switching costs.⁷ Shy too finds that compatibility is the equilibrium outcome if the product is subject to network effects.

Both these models assume random transaction patterns: each additional user is equally relevant to the existing customer base. As the previous section shows, however, this is not the case for many networks. Foreign users are generally less relevant than domestic ones. Such spatial transaction patterns have received relatively little attention. A few models exist, but they focus on unsponsored standards. For example, Ellison (1993) analyses agents located on a circle. These agents face a choice between two standards, preferring the standard of their immediate neighbors. Given sufficient local externalities, the system will converge to universal compatibility, where all agents use the same standard. Cowan and Cowan (1998) model agents on a lattice. These too face a choice between two standards, again preferring the standard of their immediate neighbor. In addition to this local positive externality, however, the authors introduce a global negative externality. This leads to coexistence of standards, where each standard occupies an enclave or region. The models of Ellison and of Cowan and Cowan assume homogeneous landscapes without borders. As a result, the enclaves of Cowan and Cowan drift across the lattice as the model iterates. In real life, however, the enclaves tend to be countries, which are geographically

⁶Banks can generally control access to their networks. For example they can deny access to their ATMs. Similarly, membership of credit and debit card networks has been subject to fees and conditions.

⁷Like differentiation, this enables monopolistic pricing. Price setting is limited by the fact that if one firm sufficiently undercuts the price of the other firm, it can compensate customers for switching costs and lure them away from its competitor.

fixed. The model of Bassanini and Dosi (1998) does explicitly consider ‘countries’. They apply a Polya urn model to an environment with multiple interacting pools of consumers, and find that different outcomes can occur for different pools, in line with the observed reality of national standards. The Polya urn model, however, analyzes the adoption of unsponsored standards. Furthermore, it focuses entirely on the initial adoption; it does not consider subsequent migration to a common standard.

In summary, there are good models to analyze the compatibility decision for sponsored standards, as long as agents interact randomly. The effect of national transaction patterns, however, remains to be explored. The next section introduces a model to do just that.

3 The model

Section 3.1 assumes random transaction patterns. The model then leads to the familiar equilibrium result that two firms offering differentiated network products prefer to establish compatibility. This model and its outcomes then serve as a reference to analyze the impact of non-random transaction patterns. This is done in section 3.2.

3.1 Basic model with random transaction patterns

Two firms, A and B , are located at either end of the unit interval and compete à la Hotelling. Each customer buys exactly one unit of the good from the firm that offers the lowest price corrected for transportation cost, which are equal to t per unit of distance between the customer and the supplying firm. Without loss of generality the number of customers is normalized to one, and marginal costs to zero. Let p_i , s_i and π_i , $i \in \{A, B\}$, be the price, market share and profit of the two firms. The equilibrium values of these parameters, denoted with an asterisk (*), can be derived using the standard Hotelling approach. Market shares are defined by the marginal customer who is indifferent between buying from either firm, because their net prices, corrected for transportation costs are equal:

$$p_A + s_A t = p_B + (1 - s_A) t \Leftrightarrow s_A = \frac{p_B - p_A + t}{2t}. \quad (1)$$

Profits are then:

$$\pi_A = p_A s_A = \frac{p_A p_B - p_A^2 + p_A t}{2t}.$$

The first order condition for profit maximization is:

$$\frac{\partial \pi_A}{\partial p_A} = \frac{p_B - 2p_A + t}{2t} = 0.$$

Since equilibrium is symmetrical, this leads to the standard Hotelling result:

$$\begin{aligned} p^* &= t \\ s^* &= \frac{1}{2} \\ \pi^* &= \frac{t}{2}. \end{aligned} \tag{2}$$

Assume now that the goods offered are subject to network benefits b per user of the network. Each firm offers a proprietary standard to its consumers, unless both firms decide to offer each other compatibility. If the goods of the two firms are incompatible, each good offers network benefits equal to bs_i (since the number of consumers is normalized to one). To reflect these effects we can define hedonic prices \hat{p}_i that are corrected for network benefits:

$$\hat{p}_i \equiv p_i - b \quad \text{if the networks of } A \text{ and } B \text{ are compatible} \tag{3}$$

$$\hat{p}_i \equiv p_i - bs_i \quad \text{if they are not.} \tag{4}$$

If both networks are compatible, hedonic prices as defined in (3) can be substituted into (1). Because the network benefits are the same for the products of both firms (since their networks are compatible) the corresponding terms ‘cancel out’, and equilibrium prices and profits are the same as without the network effect.⁸

If networks are incompatible we have to substitute (4) instead of (3) into (1). To keep the algebra simple, let unit transportation cost t be normalized to one, so that p_i and b are expressed as multiples of t . The above mentioned substitution then gives:

$$p_A + bs_A = p_B + b(1 - s_A) \Leftrightarrow s_A = \frac{p_B - p_A + 1 - b}{2(1 - b)}.$$

⁸Since $\hat{p}_i^* \equiv p_i^* - b = 1 - b$, the full network benefit accrues to the consumer. The network benefits are equal for both firms, and thus they act exactly like the marginal costs in the original Hotelling model (but in the opposite direction): they affect consumer welfare, but not firm profits.

The system now has an internal solution iff $b < 1$; for $b \geq 1$ the market ‘tips’: either firm captures the whole market.⁹

If $b < 1$ we can use the standard Hotelling approach and substitute the above expression in the profit function ($\pi_i = p_i s_i$). By then taking the first order condition we get the following symmetrical equilibrium:

$$\begin{aligned} p^* &= 1 - b \\ s^* &= \frac{1}{2} \\ \pi^* &= \frac{1}{2} - \frac{1}{2}b. \end{aligned} \tag{5}$$

By comparing (5) with (2) it follows that prices and profits are lower compared to the situation where both firms offer compatible network products.

We can now model firm actions as a two-stage game. In stage 1 each firm decides whether to offer and accept compatibility with the other firm. Compatibility is only established if both firms agree. In stage 2 they compete on price. It then follows that the unique (Nash) equilibrium outcome of stage 1 is that the two firms establish compatibility, because profits for both firms are always higher under compatibility. This outcome also maximizes welfare. Compatibility raises firm profits by b , while it reduces the hedonic price to consumers by $\frac{b}{2}$, leading to a net welfare gain of $\frac{b}{2}$.

Result 1 With homogenous transaction patterns, two firms will settle on compatibility, which is also the socially optimal solution.

3.2 The effect of autarkic transaction patterns

How does result 1 change if transaction patterns are highly national (as shown by table 1)?¹⁰ Let the above Hotelling model be adapted as follows. The unit interval is divided into two halves (‘countries’) of equal

⁹This result was obtained for a wide class of differentiated network good models by DePalma and Leruth (1993). The essence of their proof is that if $b \geq t$ the network benefits exceed the transportation costs even for the most distant customer. All customers thus join the largest network and the system ‘tips’ to the standard of either firm: an increase in the share of a firm increases the network benefits to a user by an amount larger than the increase in transportation cost for the marginal consumer. Instead of an internal solution where two incompatible standards share the market, there are now two corner solutions where either firm captures the whole market.

¹⁰As discussed earlier, this result is in line with other models of differentiated network goods, like those of Matutes and Regibeau (1988) and Shy (2001). The reason for not picking either of these two models, is that neither model can be

size. If transaction patterns were random, each consumer would perform half of his transactions (payments, phone calls etc.) with consumers in his own country (i.e. his own half of the unit interval), and the other half of his transactions with consumers in the other country.

Assume instead that the two halves are somewhat autarkic: consumers on each half of the interval transact mostly within their own half of the unit interval. Consider, for example, inhabitants of Elzas-Lorraine in France, near the German border. They are probably somewhere between France and Germany in ‘taste-space’; yet most of their transactions will be within France (paying Gaz de France, France Telecom, taxes, etc.).

Assume therefore that instead of half their transactions, consumers perform only a fraction $\frac{\delta}{2}$ of their transactions with consumers in the other ‘country’, and a fraction $1 - \frac{\delta}{2}$ with consumers in their own country. Here $\delta = 1$ corresponds to random interaction, and $\delta = 0$ represents complete autarky (i.e. consumers transact only with consumers on their own side of the interval).

If $\delta < 1$, the equilibrium outcomes of the model are as follows (the results are derived in the appendix):

$$\begin{aligned} p^* &= 1 - b + \sqrt{D} \\ s^* &= \frac{1}{2} \\ \pi^* &= \frac{1}{2} - \frac{1}{2}(b + \sqrt{D}). \end{aligned} \tag{6}$$

The variable D captures the autarky effect:

$$D = \{1 - b\}^2 - \{1 - b(3 - 2\delta)\}^2.$$

Note that for $\delta = 1$ we get $D = 0$, and (6) reduces to (5), the equilibrium outcomes for random transaction patterns.

For $\delta < 1$, firms will prefer compatibility if $b - \sqrt{D} \geq 0$.¹¹ After some rearrangement of terms, this condition can be written as:

$$b \geq \frac{4(1 - \delta)}{(3 - 2\delta)^2}.$$

extended to deal with national transaction patterns. Matutes and Regibeau’s Mix & Match model analyzes the combination of two components (as in hi-fi-equipment or cameras and lenses). Shy’s model could be adapted to analyze two countries. In his model, however, there is no differentiation between consumers in a country: they either all stick to the current provider, or all switch to another. Thus a situation where only some consumers use a foreign standard never occurs.

¹¹If $b - \sqrt{D} = 0$ firms are indifferent. I assume that in that case they establish compatibility.

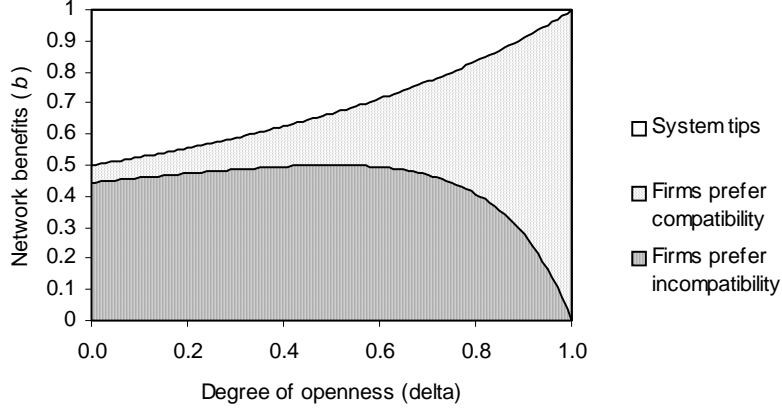


Figure 1: Range of values of b and δ where firms prefer (in)compatibility, transaction patterns are not random but semi-autarkic ($\delta < 1$)

This is the lower curve in figure 1. For values of b below this curve, duopolists prefer incompatibility. Figure 1 also shows the curve $b = \frac{1}{2-\delta}$. For values of b on or above this curve, the DePalma and Leruth (1993) condition is no longer met, and the system ‘tips’ if firms maintain incompatible standards. Note that if $\delta = 1$ and $0 < b < 1$, duopolists always prefer compatibility over incompatibility, in line with the results of section 3.1. For smaller δ , however, duopolists on either side of a border increasingly prefer incompatibility.

Result 2 For $\delta < 1$ and $b < 1$, firms on either side of a border make the following (in)compatibility decision:

1. If $b < \frac{4(1-\delta)}{(3-2\delta)^2}$ both firms prefer to maintain incompatible versions.
2. If $\frac{4(1-\delta)}{(3-2\delta)^2} \geq b > \frac{1}{2-\delta}$ the equilibrium is the same as with random transaction patterns: both firms prefer compatibility.
3. If $b \geq \frac{1}{2-\delta}$ the DePalma-Leruth condition for coexistence of incompatible networks is no longer met.

Firms prefer incompatibility when b is low compared to δ , because the network benefits of compatibility are smaller than the gains from the decreased competition resulting from incompatible standards across borders. For intermediate values of b , the network benefits of compatibility dominate and we get the (familiar) result that both firms prefer

	Incompatibility	Compatibility	Gain
W_f	$1 - b + \sqrt{D}$	1	$b - \sqrt{D}$
W_c	$-(1 - b + \sqrt{D}) + (1 - \frac{\delta}{2})b$	$-1 + b$	$-(1 - \frac{\delta}{2})b + \sqrt{D}$
W_s	$(1 - \frac{\delta}{2})b$	b	$\frac{\delta}{2}b$

Table 2: Welfare effects of compatibility decision

compatibility. For high values of b the system tips if firms maintain incompatible standards; depending on the risk profile of either firm, and their estimate of the chances to win the standards battle, they may prefer to fight it out rather than establish compatibility.

3.3 Welfare analysis

Table 2 summarizes the welfare impact of the compatibility decision. Firm welfare (W_f) is the sum of firm profits. Consumer welfare, (W_c) is defined as minus the hedonic price, while social welfare (W_s) is simply equal to $W_f + W_c$.

It is useful to first consider the polar cases of random transaction patterns ($\delta = 1$) and total autarky ($\delta = 0$), and then look at the intermediate case.

Random transaction patterns ($\delta = 1$). In that case $D = 0$ and the gain from establishing compatibility is always positive for both firms, making it the unique equilibrium outcome. Consumers are worse off under compatibility, since prices rise by b , while their network benefits only increase by $\frac{b}{2}$. But since firms gain twice as much as consumers lose, the overall welfare is higher under compatibility. Thus the equilibrium outcome is also the socially desirable outcome.

Complete autarky ($\delta = 0$). The compatibility decision does not impact social welfare. It does however transfer welfare between firms and consumers. Firms gain from incompatibility if $0 < b < \frac{4}{9}$. Their gain, $b - \sqrt{D}$, represents a pure welfare transfer from consumers to firms (compared to a situation of compatibility). This transfer is 0 for $b = 0$ and $b = \frac{4}{9}$, reaching a maximum value of $\frac{1}{2}$ for $b = \frac{1}{6}$. Hence for very low δ , firms may indeed have a large incentive to prefer incompatibility, leading to an equally large loss for consumers.

Some autarky ($0 < \delta < 1$). Incompatibility then leads to a welfare loss of $\frac{\delta}{2}b$. If firms prefer incompatibility, they do so because it raises their profit. Hence consumers must face a loss that is bigger than the social welfare loss (since firms gain from incompatibility). As δ grows (countries are more connected) so does the loss in social welfare, reaching

a maximum of $\frac{1}{6}$ for $\delta = \frac{3}{4}$ and $b = \frac{4}{9}$.¹² The loss to consumers, by contrast, goes down as δ increases, because this diminishes the dampening effect on competition.

Result 3 When transaction patterns are highly autarkic, incompatibility leads to a substantial loss in consumer welfare and a modest loss in social welfare. For more integrated patterns (large δ) incompatibility, while less likely to be preferred by firms, leads to more substantial losses in both social and consumer welfare.

An important feature of the model is that it assumes fixed demand and takes firm cost structures as given (both are basic features of the underlying Hotelling model). This means that the loss in social welfare is entirely due to the direct impact of incompatibility, which reduces the network benefits to consumers and society as a whole. Because demand is fixed, the lack of competition does not lead to the ‘deadweight loss’ associated with a monopoly. And because cost structures are given, competition does not reduce X-inefficiencies. The model therefore likely underestimates the social losses due to incompatibility if demand is highly elastic and/or if profit pressure increases efficiency.

There is empirical evidence that the price sensitivity of the demand for payment services is indeed low. Using cross-country data, Humphrey, Pulley, et al. (1996) find own price elasticities of 0.09-0.26; Murphy (1991) finds that per item charges on checks reduce usage by only 10%; and several authors have been puzzled by the willingness of consumers to pay high interest rates on credit card debt.¹³

The second assumption (cost structures are given) gets much less empirical support. As discussed earlier, the survey by Berger DeYoung, et al. (2000) strongly suggests that foreign competition significantly reduces X-inefficiencies. This would imply that the social loss from incompatibility is larger than the model suggests.

3.4 Impact of migration costs on harmonization

In some cases compatibility can be established by ‘flipping a switch’, by opening up a network. In other cases, however, migration involves real

¹²This is the maximum welfare loss subject to the constraint that firms indeed prefer incompatibility, i.e. $b < \frac{4(1-\delta)}{(3-2\delta)}$.

¹³Humphrey, Kim, et al. (2001) analyze the impact of prices on payment instrument usage in Norway. They find much higher own price elasticities: 0.75 - 0.96. However, it is not clear that the dramatic substitution of checks by electronic payments was (solely) due to pricing, since the Netherlands, for example, witnessed a similarly rapid substitution without the introduction of e.g. a consumer charge per check.

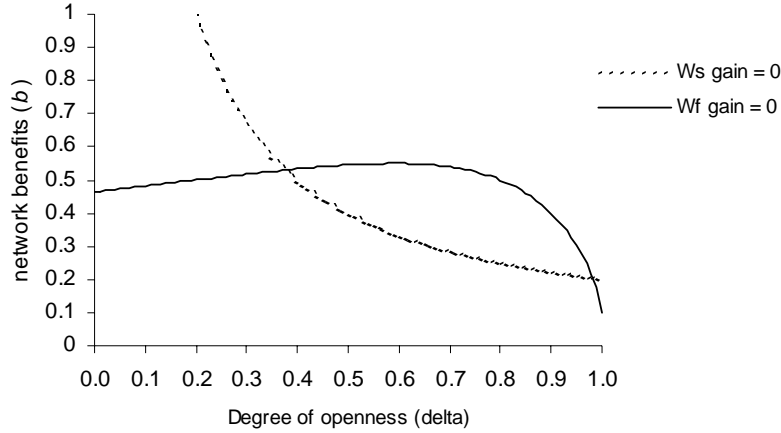


Figure 2: Occurrence of excess inertia as a function of autarky and network benefits, $c = 0.1$

costs, such as educating consumers, issuing new cards, assigning new (account) numbers etc.

Let c denote the cost of migrating a single user to another version of the network technology. The earlier analysis implicitly assumed $c = 0$. If $c > 0$ this poses an additional hurdle for firms that start with incompatible standards and want to make them compatible. Either firm will migrate if the gain in profits outweighs migration costs:

$$\frac{1}{2}c < \frac{1}{2}(b - \sqrt{D}). \quad (7)$$

For $c = 0.1$, the resulting relationship is shown by the solid line in figure 2.¹⁴ Compared to the lower curve in figure 1, migration costs shift the curve upwards, increasing the area where firms prefer to maintain incompatible versions. On the other hand, migration costs reduce the welfare gain of establishing compatibility. The dotted-line curve in figure 2 represents the points where the net effect on social welfare is neutral because migration costs just offset the welfare gain of compatibility:

$$c = \frac{\delta}{2}b$$

¹⁴After some reshuffling expression (7) can be reworked to:

$$b = \frac{c - 2\delta + 2 - 2\sqrt{\delta^2 - \delta c - 2\delta - 2c^2 + c + 1 + 3\delta c^2 - c^2\delta^2}}{9 - 12\delta + 4\delta^2}$$

This relationship is shown in the graph.

The preference of firms to maintain incompatibility leads to a social loss only in the area between the two curves. And for δ sufficiently small, ‘excess inertia’ (firms prefer incompatibility while migration would raise social welfare) is no longer a social problem.

Result 4 Migration costs increase the preference of firms to maintain incompatibility, but mitigates the associated welfare loss, especially if transaction patterns are highly autarkic (small δ).

Since migration costs represent real costs, they reduce the welfare loss of maintaining incompatibility. This is especially the case if δ is very small: the benefits of a common standard are then quite small relative to the cost of migration. It is therefore not surprising that the net welfare benefit of migration to a compatible standard is negative if transaction patterns are highly autarkic. As before, however, this does not consider reduced X-inefficiencies caused by increased competition. If these are taken into account, welfare gains of compatibility would increase and the dotted line in figure 2 would shift downwards. In that case migration costs may form a substantial barrier to establishing welfare enhancing compatibility.

4 Application to European payments

Payments offer an interesting application of the model. Three payment instruments were distinguished in table 1: cash, card payments (including ATM withdrawals), and credit transfers.

While cash was indeed harmonized with the introduction of the Euro, the instrument is not a commercially sponsored standard (the sponsoring central banks are not profit focused); therefore the model of the previous section cannot be applied to cash.

In the case of cards, the purely technical compatibility issues are relatively minor. All ATMs can accept practically all cards from all countries, and the same is true for most POS terminals. Yet banks have maintained largely national card systems. Most countries have national schemes, such as Bancontact/MisterCash in Belgium and EC Cash in Germany. While these cards can be used at foreign Point of Sales using the Maestro function, most merchants only accept the domestic cards. The current set-up makes it practically impossible for a Belgian bank to sign up Dutch customers, unless that bank sets up a Dutch operation that joins the local processing network, supports the Dutch protocols, etc.

For international credit transfers, the technical incompatibility issues run deeper than in cards. Each country has its own account numbering

system, and credit transfer format. And an instrument like direct debit is subject to very different rules in various countries.¹⁵

This lack of standardization in credit transfer payments became quite visible with the introduction of the physical Euro in 2002, which created a single (cash) payment instrument that could be used throughout 12 EU countries. By that time, the European Commission had been urging banks to improve the situation for several years, as it considered the lack of a proper Pan-European payments infrastructure an impediment to the further integration of Europe. From 1990 to 2000 a series of white papers and Directives urged banks to take action, all to little avail.¹⁶ Increasingly frustrated with this lack of progress, the European Parliament passed Regulation EC 2560/2001 (European Community, 2001). This regulation forced banks to maintain the same tariff structure for domestic and international Euro payments below EUR 12,500, and to implement a common account numbering system (IBAN).

Reality is of course far more complex than the 2-firm model laid out in the previous section. Nevertheless, it offers some basic insights into the compatibility and harmonization decision for semi-autarkic networks, such as payment systems.

Let f denote cross-border transactions as a share of all transactions. As summarized in table 1, $f^{cards} \approx 5\%$ and $f^{transfers} \approx 0.5\%$.¹⁷ These quantities give an indication of the value of the parameter δ . The duopoly model of the previous section put the share of foreign transactions at $f = \frac{\delta}{2}$. In a more general setting, with N countries with shares s_i , $i = 1..N$, the share of foreign transactions, denoted f_i , is equal to:

$$f_i = \delta(1 - s_i).$$

Summing across all countries we get:

$$f = \sum_{i=1}^N s_i f_i = \delta(1 - H)$$

where f is the overall share of cross-border transactions and $H = \sum s_i^2$ is the Herfindahl index. If we approximate the s_i for European countries

¹⁵These rules have to do with things like consumer protection: can an automatic debit be reversed by the consumer? Up till how many weeks after the transaction?

¹⁶For an overview, see European Commission (2000).

¹⁷Estimate of $f^{transfers}$ is based on data from BIS (2004) and ECB (2003). Cross-border transfers are estimated from number of swift category-1 messages. The total number of transfer transactions was based on the sum of direct debits, domestic transfer payments, half of all checks (assuming the other half was written at the POS) and cross-border transfers. Estimate of δ^{cards} based on data from Visa and MasterCard.

by their population share, we get $H = 0.14$, and

$$\delta^{transfers} = \frac{f^{transfers}}{1 - H} \approx \frac{0.5\%}{0.86} \approx 0.6\%$$

$$\delta^{cards} = \frac{f^{cards}}{1 - H} \approx \frac{5\%}{0.86} \approx 6\%$$

We can conclude that the low values of δ put us clearly on the far left of figures 1 and 2.¹⁸

Overall, the current landscape in both instruments is in line with Results 1 and 2: perfect compatibility within countries, and much more limited compatibility across countries. According to results 3 and 4, the welfare loss of international incompatibility depends on migration costs c . One could assume that for cards the costs of moving to a technically compatible system are small: $c \approx 0$. In that case, result 3 would apply to card payments, suggesting that the welfare loss of incompatibility may well be substantial. It is therefore not surprising that the ECB has announced that by 2007 it will require banks to accept all European debit cards at the POS.¹⁹ For credit transfer payment systems, per customer migration costs might be significant. According to result 4, this would make migration to a common European transfer payment standard even less attractive to banks.

And indeed, banks did not respond to the EC Regulation by establishing total compatibility for credit transfers. Instead, they agreed to establish at least one (EBA step2), and possibly more, Pan European Automated Clearing Houses (PEACHs). These were primarily envisioned as a solution for cross-border payments, acting as an overlay for the domestic systems. While eventually some domestic volumes might migrate to this PEACH, this was not foreseen for the short or even medium term.²⁰ Given the substantial costs of migrating all domestic systems to a common infrastructure, account numbering system etc., this decision makes perfect sense from the point of views of banks. And it is in line with the dynamics of the model of section 3. However, it also means that national payment systems will continue to be one of the (many) barriers to European banking integration.

¹⁸Obtaining an estimate for b is trickier, because b is expressed as a multiple of t , the transportation costs in the Hotelling model, which is an unobserved variable.

¹⁹Speech by Gertrude Tumpel-Gugerell, member of the Executive Board of the ECB, delivered on 6 September 2004 (available through www.ecb.int).

²⁰EBF (2002).

5 Discussion of results

This paper analyzes the compatibility decision for network products with sponsored standards in the presence of (somewhat) autarkic transaction patterns. A simple 2-firm model showed that transaction patterns can be very relevant for the compatibility decision. National transaction patterns may lead firms to prefer compatibility **within**, and incompatibility **across** countries. The basic reason for this is that incompatible networks act as a barrier between countries, giving firms a certain degree of monopoly power in their home country.

For the sake of simplicity, the model focusses on transaction patterns at the expense of other aspects. Importantly, it uses the Hotelling framework which assumes fixed demand and takes firm costs as given. As discussed, the former assumption may be reasonable in the case of payments, but the latter is more dubious. The benefits of migrating to a common standard may therefore be substantial, even if the low number of cross-border transactions and likely migration costs limit the direct welfare gains. There may thus be a clear divergence between the interests of firms and a social planner. This is a fortiori the case if the benefits of increased trade in European goods and services (due to cheaper/simpler cross-border payments) are taken into account.

Several areas remain to be further explored. On the empirical side, it would be fascinating to analyze transaction patterns within countries, for example between individual USA states or German Länder. Is there comparable autarky at this level? On the theoretical side, the model could be expanded to deal with multiple firms within a country that compete against each other, as well as against firms in the other country.

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Appendix: Model outcomes for $\delta < 1$

To find equilibrium outcomes for the model with autarkic transaction patterns, this appendix first derives market share functions, then uses these to calculate response functions and equilibrium prices and profits.

1. Market share functions. If $\delta < 1$, the market share functions are no longer continuous if firms have incompatible standards. To see that, take the perspective of firm B , as it tries to expand market share beyond $s_B = \frac{1}{2}$. Attracting the nearest customer in the other ‘country’ requires a discontinuous lowering of price, since the network benefits for that customer are limited: he interacts mostly with customers of country 1, who use the incompatible network of firm A . The network benefits of the ‘last’ customer in country 2 are equal to:

$$\mu \left(1 - \frac{\delta}{2} \right) b. \quad (8)$$

since he performs a fraction $\frac{\delta}{2}$ with ‘foreign’ customers and thus a fraction $1 - \frac{\delta}{2}$ with domestic customers, and only domestic customers use his network. The network benefits of the first ‘foreign’ customer of firm B (located in country 1) are equal to:

$$\frac{\delta}{2}b. \quad (9)$$

since this customer can only use the network of firm B for his foreign transactions. Thus, to attract the first foreign customer, the price needs to drop by the difference between (8) and (9) or:

$$1 - \frac{\delta}{2} b - \frac{\delta}{2}b = (1 - \delta)b.$$

Hence all prices that satisfy $|p_A - p_B| \leq (1 - \delta)b$ will lead to $s_A = s_B = \frac{1}{2}$ (note that if $\delta = 1$, the required drop is 0, and the function is continuous). Assume $p_B < p_A - (1 - \delta)b$. In that case the marginal customer, with address s_A , will reside in country 1. By definition the address of this marginal customer is s_A . Of all his transactions, a share $1 - \frac{\delta}{2}$ is with customers in country 1. Of these, a fraction $2s_A$ is using the network of firm A . Hence a share of his transactions equal to $1 - \frac{\delta}{2} 2s_A = (2 - \delta)s_A$ is with customers on network A and $1 - (2 - \delta)s_A$ is with customers on network B . Now for this marginal customer the benefits of both networks need to be the same:

$$p_A + ts_A - b(2 - \delta)s_A = p_B + t(1 - s_A) - b[1 - (2 - \delta)s_A].$$

Normalizing $t = 1$ and solving for s_A :

$$\begin{aligned} 2s_A - 2b(2 - \delta)s_A &= p_B - p_A + 1 - b \Leftrightarrow \\ s_A &= \frac{p_B - p_A + 1 - b}{2 - 2b(2 - \delta)}. \end{aligned} \quad (10)$$

Using a similar approach for the case where the marginal customer is in country 2, we get the following share function for s_A (and $s_B = 1 - s_A$):

$$\begin{aligned} \text{if } |p_A - p_B| \leq (1 - \delta)b: \quad s_A &= \frac{1}{2} \\ \text{if } p_A - p_B > (1 - \delta)b: \quad s_A &= \frac{p_B - p_A + 1 - b}{2 - 2b(2 - \delta)} \\ \text{if } p_B - p_A > (1 - \delta)b: \quad s_A &= \frac{p_B - p_A + 1 - b(3 - 2\delta)}{2 - 2b(2 - \delta)}. \end{aligned} \quad (11)$$

2. Equilibrium prices and profits. We now get a situation where a firm can only expand its market share above $\frac{1}{2}$ if it substantially drops its

price, ‘undercutting’ its rival. To analyze this type of situation I use the concept of Undercut Proof Equilibrium (UPE), described in Shy (2002). It defines equilibrium as a situation where neither firm can profitably undercut its rival’s price. Let π_i^* , p_i^* and s_i^* denote UPE profits, prices and shares. Because of the symmetry $s_A^* = s_B^* = \frac{1}{2}$. Suppose firm B tries to undercut its rival, who is charging p_A^* , by offering a price p_B . We can now maximize firm B profits: $\pi_B = (p_B - c)s_B$. The first order condition is:

$$\begin{aligned} \frac{\partial \pi_B}{\partial p_B} &= s_B + (p_B - c)s'_B = 0 \Leftrightarrow \\ p_A^* - p_B + 1 - b(3 - 2\delta) &= p_B - c \Leftrightarrow \\ p_B &= \frac{p_A^* + 1 - b(3 - 2\delta) + c}{2}. \end{aligned}$$

If firm B indeed selects this price p_B we get:

$$\begin{aligned} s_B &= \frac{p_A^* - p_B + 1 - b(3 - 2\delta)}{2 - 2b(2 - \delta)} = \frac{\frac{p_A^* + 1 - b(3 - 2\delta) - c}{2}}{2 - 2b(2 - \delta)} \\ \pi_B &= (p_B - c)s_B = \frac{\frac{p_A^* + 1 - b(3 - 2\delta) - c}{2}}{2 - 2b(2 - \delta)}. \end{aligned}$$

If firm B were to charge $p_B^* = p_A^*$ (instead of undercutting firm A), its profit would be $(p_A^* - c)\frac{1}{2}$. So a price p_A^* is undercut proof if firm B cannot get a higher profit by deviating from $p_B = p_A^*$:

$$\begin{aligned} \frac{(p_A^* - c)}{2} &\geq \pi_B \\ \frac{(p_A^* - c)}{2} &\geq \frac{\frac{p_A^* + 1 - b(3 - 2\delta) - c}{2}}{2 - 2b(2 - \delta)} \end{aligned}$$

We can directly substitute $\pi_A^* = (p_A^* - c)\frac{1}{2}$ to obtain:

$$\begin{aligned} [2 - 2b(2 - \delta)]\pi_A^* &\geq \pi_A^* + \frac{1 - b(3 - 2\delta)}{2} \Leftrightarrow \\ 0 &\geq (\pi_A^*)^2 - (1 - b)\pi_A^* + \frac{1 - b(3 - 2\delta)}{2}. \end{aligned}$$

π_A^* is the highest value that satisfies this quadratic inequality. Hence:

$$\begin{aligned} \pi_A^* &= \frac{1 - b + \sqrt{D}}{2} \quad \text{with} \\ D &= (1 - b)^2 - [1 - b(3 - 2\delta)]^2. \end{aligned}$$

Because of symmetry, $\pi_A^* = \pi_B^*$. Note that if $\delta = 1$ (the case analyzed in section 3) we get $D = 0$ and $\pi_i^* = \frac{1}{2} - \frac{b}{2}$, which is exactly the result obtained in section 3 (table 1). Hence the concept of UPE converges to the standard Hotelling Nash-equilibrium as $\delta \rightarrow 1$ (as it should).