THE DUTCH BANKING CHIPCARD GAME:

UNDERSTANDING A BATTLE BETWEEN TWO STANDARDS

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Key-words: Banking, Chipcard, Chipknip, Chipper, Electronic purse, Standardization, Game theory

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Introduction

The "New Economy" refers in general to the revolution regarding information technology. Computers are known for their computational capabilities, but they are more generally 'used to store, retrieve, organize, transmit, and algorithmically transform any type of information that can be digitized – numbers, text, video, music, speech, programs, and engineering drawings, to name a few' (Brynjolfsson and Hitt, 2000). The impact of the rapid development in information technology can be seen at various levels in the economy. Managers in firms develop new processes, procedures, and organizational structures in order to benefit from the increasing abilities of computers. Markets change due to the increasing extent of outsourcing and the emergence of network organizations, in order to reduce the costs of coordination, communication, and information processing (Shapiro and Varian, 2000).

The implementation of new technologies is a time consuming process and is not without problems. For example, a firm probably faces major coordination problems in order to adjust its logistics, human resource policy, marketing, accounting, and strategy in response to, or jointly with, the adoption of new information technologies. Similarly, several markets experience fruitless efforts due to the strategic implications of lock-in and switching costs, the dynamics of positive feedback, and compatibility choices and standardization efforts.

This article presents and analyses a case with respect to a new information technology in the market for financial services. The (electronic) innovations regarding financial payments have resulted in various chipcard systems. A chipcard system for small financial transactions provides an alternative for small cash payments and small PIN payments, and saves costs. Chipcard systems have appeared in many countries, with typically one chipcard system per country. In the Netherlands, however, two competing systems were introduced. This is remarkable, since the innovation is characterized by mechanisms leading to increasing returns for which one system would be the preferred solution. Initially, all Dutch banks started preparing the chipcard project together. However, one of the banks decided to introduce a competing chipcard.

We address the question of whether the standardization efforts and compatibility choices of the two parties in the wasteful standardization war were optimal from the perspective of each party. The two competing chipcard technologies can be regarded as two standards fighting for market acceptance. Standardization theory is used because it describes mechanisms that determine whether or not competing standards will receive market acceptance. However, standardization theory hardly pays attention to market dynamics in the form of the process of action and reaction between the competitors. The detailed description of the moves and countermoves in the standardization process of the Dutch chipcard market motivates our choice for the tool of non-cooperative game theory. It supplements the standardization literature by focussing on the various moves by the banks and the consequences for the chipcard standard in the market.

The next section presents various theoretical insights regarding competing standards; the third section describes the case. The case is analyzed in the fourth section, and the final section will summarize our findings and formulate several conclusions.

Theory on competing standards

Scientists, especially economists, have described and analyzed several examples of competing standards. Examples include standards for cellular telephone services (West, 1999), microcomputers (Hergert, 1987), interactive videotex (Schmidt and Werle, 1998), and high definition television (McKnight, Baily and Jacobson, 1996).

One banking chipcard standard has obvious advantages, such as economies of scale, transparency and the avoidance of the costs of converting to an alternative standard. However, the standardization process often results in a battle between various designs because the advantages of a particular standard are unevenly distributed between the involved parties, so that the efficient standard may not emerge. The number of users of a standard is called the *installed base* (Farrell & Saloner, 1986). There may be one solution, commonly used (example: QWERTY typewriter keyboard), a limited number of sets of different solutions (example: ANSI X 12 or EDIFACT syntax rules for EDI messages), or a large number of different isolated solutions (for example the use of function keys as shortcuts in software operations).

Once the installed base has been created, users tend to stick with one standard even when the technology has become old-fashioned or inferior. The reason for this is that conversion to a new standard is costly. This is called *lock-in* (Arthur, 1988). QWERTY is a famous example: conversion to an easier keyboard would require expensive and time-consuming courses for typists to learn the new system.

A *dominant design* is 'the distinctive way of providing a generic service or function that has achieved and maintained the highest level of market acceptance for a significant amount of time' (Lee et al. (1995, p. 6). Users determine a dominant design's emergence. Once a limited number of them have chosen to implement a certain solution, others tend to choose the same. They *bandwagon* the early adopters' choice. The reasons for bandwagoning are, in logical order (each reason presupposes the foregoing):

- *Availability of the solution*: often, the only reason for bandwagoning is the availability of the solution. Bandwagoning prevents reinventing the wheel.
- *Informational increasing returns*: a solution that is more adopted enjoys the advantage of being better known. This stimulates its spread (Arthur, 1988, p. 68).
- *Avoiding uncertainty*: an already implemented solution has proven to be feasible. Most users dislike experimentation and uncertainty (Cowan, 1991, p. 811; Cowan, 1992, pp. 285-291) and, therefore, bandwagon the early adopters' choice.
- *Economies of scale*: in general, standard solutions are cheaper than tailor-made ones.
- *Functionality*: in the case of compatibility, there is a functional need for bandwagoning as interoperatability is not possible without sticking to the specifications used by another actor, or only possible by adding a "converter." Such functionality applies, for instance, to tracking and tracing systems.
- *Network externalities*: in a telephone system with n users, the number of possible connections for one user is n-1, the total number of connections is n(n-1). So the

total functionality of the system is proportional to the number of users raised to the square. The more overall functionality, the more functional profit individual users gain from their investments and the more willing they are to bandwagon the system (Katz and Shapiro, 1985). Apart from such *direct network effects*, *indirect network effects* can apply. The value of, for instance, a barcode system increases with the availability of scanning equipment. The more barcode users, the more scanners will be available and the lower their price. Thus, without improved system functionality for the individual users, they profit from growth of the number of users: *indirect network effects* (Nicklas, 1997, p. 195).

Some technologies need standardization to obtain enough critical mass. Without standardization they would not diffuse. Therefore, it can be profitable for a company to have competitors that offer clone products, using the innovator's technology, since, due to network externalities, this enhances the user-quality of the company's products, due to network externalities (Connor, 1994, pp. 180-181). In the case of network externalities, the lock-in effect is extra strong. Conversion to a new, better, technology is only profitable when a large number of players do the same, so nobody dares to change since, unless a collective action is organized, he does not know whether others will follow.

Because of the bandwagon effect, the first standard available has an advantage to later, competing standards, if any. The *first agent* is the first player to set a standard for a certain topic. He will not always be the winner in terms of profit. In spite of having income from early adopters, and advantages in terms of goodwill and brand loyalty, other early entrants using the same standard can *free-ride* on the first mover's investment in infrastructure and training (Landis Gabel, 1994, p. 144). In a market with great uncertainty, the second mover can learn from the first mover's mistakes and gain a competitive advantage by improving product quality or by positioning this second mover's offerings closer to the customer's preferences (Nicklas, 1997, p. 200). In a case about microprocessor standards, Swann (1987, p. 260) also mentions the attractiveness for the new entrant to produce a second-source copy of an industry standard rather than introduce their own product.

It is not a law of nature that first agents dominate the game of competing standards. Often, several standards can co-exist, each of them having a part of the market. In the case of network externalities, however, it is more probable that one standard will win, because this is the most profitable situation from a users point of view, not counting the drawbacks from monopolistic situations. Of crucial importance for the success of standards in such situations, however, is not their current rate of use, but the expectation of their future use. In such a situation a standard proposed by a powerful party, having little or no current market share, may displace an existing standard that has a considerable market share. The shift from *WordPerfect* to *Word* in text processing was an example of this; the expectation that *Word* would win was related to the shift from *MS DOS* to *Windows*. Moreover, *Word* offered additional functionality and partly backward compatibility to *WordPerfect*. A powerful party like *Microsoft* can be called a *dominant agent*. Its dominance may be due to, for instance, market share (Braunstein & White, 1985), power image, or status.

It may even be possible that two standards in the market can exist concurrently. When competing standards differ in the advantages they generate for different categories of users, each of them may develop their own installed base and subsequent lock-in effects, which may prevent one of them from winning (Arthur, 1988, pp. 69-73). In a market with network externalities and competing standards, the preferred solutions are: (1) an adapter that enables conversion from the implementation of one standard to that of the other standard, assuming that costs of an adapter are not too high (Baake & Boom, 1997), or (2) a joint modification (Cowan, 1992, p. 281). These solutions increase the functionality of the system for customers. For suppliers, they enhance the likelihood that the technology, as such, generates enough customer confidence to obtain the critical mass necessary for a break-through. Such gateway technologies that bridge the two incompatible technologies generate ex post compatibility (Nicklas, 1997, p. 197). Competing standards may cause market and buyer uncertainty as they do not know which one, if any, will win – they face the danger that products which fail to receive enough support cease to be supported and further improved (David, 1995, pp. 25-26). Licharz (1997) has argued this in a case about IBM's OS/2 standard for operating systems. OS/2 competed with the *Windows 95* standard and reinforced the loss of market share of IBM's own DOS standard. On the other hand, an early choice of one standard can build confidence to invest in a new technology. The early setting of an American standard for color television was, on the one hand, the reason why colors in the USA are prone to deterioration in transmission through the ether. On the other hand, this situation strengthened the leading role of the US in producing programs and films and provided the public with the new technology at an early stage (Overkleeft & Groosman, 1987, p. 113), even though it took another ten years for any real breakthrough (Farrell & Shapiro, 1992, p. 54).

These insights from standardization theory (as surveyed by De Vries (1999, chapter 12) should be extended by paying attention to the uneven distribution of the benefits of a particular standard. This will elicit strategic behavior by the various parties in order to try to push the emergence of a standard in a favorable direction. Strategic decisions may be particularly beneficial while there is still a lot of uncertainty regarding market demand. This uncertainty concerns the size as well as the composition of market demand. The uncertainty regarding the size of market demand relates to the consumers who are willing to adopt the new technology only when one standard emerges. The uncertainty regarding the composition of the demand relates to the willingness of the consumers to switch to another standard. Both types of uncertainty put a premium on strategic moves like pre-empting available production capacity, rapid expansion of the distribution network, and distributing parts of the product for free (Tirole, 1988; Varian and Shapiro, 1999). This may result in a decision by a party to withdraw from an initially agreed on system, despite the harmful effects that are involved for all parties together.

The Dutch banking chipcard case

The following description of the Dutch banking chipcard case is based on a documented chronological case (De Vries and Nielen, 2001) and describes the market structure and its institutions, the war between competing chipcards, and the resolution of that war.

Market structure and institutions

Three companies dominate the Dutch banking scene: *ABN-Amro*, *ING Group* and *Rabobank*. Together, they have a market share of nearly 90 percent. *ING Group*'s ancestors are *NMB, Postbank* and the insurance company *Nationale Nederlanden.* The *Postbank* used to be state-owned. *NMB* was a private bank; its name was changed into *ING Bank Nederland*. There are two separate groups of cash dispensers, one offered by the *Postbank* and the second one by the other banks, including *ING Bank Nederland*. So, related to its history, the *ING Group* supported two payment infrastructures.

The *Postbank* and other banks co-operate in *Interpay*, which is a clearinghouse service provider mutually owned by the Dutch banks. *Interpay* offers, among other services, credit card, payment transfer, switching and clearing services to its members and customers. Above all, it offers services for debit-card payments and payments by giro (national transcash service), including providing the connection to the proprietary *Postbank* payment circuit. In their cooperative body *Interpay* the banks had agreed to start preparations for a multifunctional *Chipknip.*

In 1994, the banks decided to introduce chipcard payments for small transactions. These would form an alternative for small cash payments and also for small PIN payments. The user electronically downloads and stores money on the card in advance, before spending it in a shop. So the chipcard is like an electronic purse. The maximum amount of money is usually NLG 500, being approximately EUR 230 or USD 200. Purchases can be made at so-called Point Of Sale (POS) terminals. The card can be reloaded at so-called reload points, usually placed next to the traditional Automatic Teller Machines (ATMs), at public pay phones, or at home, the latter being done via a home device connected to the telephone network.

Saving costs was the main reason for introducing a common chipcard for small transactions. For banks and merchants, chipcard payments are cheaper than on-line debit card payments (because they make an electronic connection to their bank once a day instead of at each payment transaction) or cash payments (because of the speed of payment and because of less coin exchange with the bank). The electronic purse enables banks to profit by yields of interest on a shared pool account. Electronic purses facilitate conversion to the Euro, because there is no problem of two different sets of coins – debiting is done automatically in the right currency.

In 1995, the *Chipknip* was introduced in the medium-sized town of Arnhem. The *Postbank* is a major employer in Arnhem because several of its departments are located in this town. The only functionality of the card concerned payments. The card used a CC 60 V1 chip. This technology proved to be successful in the project and, according to the banks, consumers were in favor of the card.

War between competing chipcards

Initially, all Dutch banks started preparing the chipcard project together. On December 8, 1995 the *Postbank* met *KPN*, the largest, formerly state-owned, Dutch telecommunication company. They formed an alliance to introduce a competing chipcard. They announced the competing chipcard *Chipper* on December 18. *Interpay*'s founding statutes state that each participant is free to choose its products. This allowed the *Postbank* (in co-operation with another *ING Group* member, *ING Bank Nederland*) to introduce the *Chipper*, while leaving them the option to return to the *Chipknip* at a later time.

The *Chipper* used the *KPN* telephone network. Public pay phones were to be re-equipped for recharging cards. In the second stage, all personal telephones would be enabled for *Chipper* payments. The *Chipper* would use superior technology enabling multifunctional use, whereas the *Chipknip* was initially only for payments. The initiators of the *Chipper* had the advantage of access to the expertise of *KPN Research* for developing the card. Additionally, the alliance offered extra market access since *KPN Telecom* had 7,500,000 customers and 8,000,000 people already had a telephone card with them that might be replaced by a *Chipper*. From the outset, the *Postbank* and *KPN Telecom* were willing to involve the other banks in the form of licenses to use their concept.

Functionality

Initially, the *Chipper* promised superior functionality. The chip to be used in the *Chipper* was more powerful than the *Chipknip*'s CC 60 V2 chip. The *Chipper* could carry more additional functionality, for instance, retailers' loyalty programs, library subscriptions, membership information, and tickets for public transport. The *Chipknip* could carry some extra information beyond its payment function, for instance identification for library use, but it was less equipped for future multi-functional use. Therefore, the *Chipknip* banks decided the *Chipknip* should also have other than payment functionality. They introduced the much stronger CC 1000 chips in January 1997. Cardholders could exchange their card for a new one. Reload points and POS terminals could handle both *Chipknip* versions. The new *Chipknip* carried 'generic' functions for identification, savings programs, and tickets. These generic functions could be activated by an authorized customer, for instance, railway tickets sold by a Railway company to its passengers, or cinema tickets sold by a chain of cinemas to its clients. The CC 1000 chips could deliver the same functionality as the chips used in the *Chipper*.

Chipper and *Chipknip* had their size, the chip and the places of contact points in common. All other features differed, for instance, the operating system, the technology for processing transactions, and control and safety measures, so the two sets of technologies were not compatible. Nevertheless, technical solutions to handle both cards had been found, but at the cost of elegance, efficiency and extra money. A practical difference between *Chipper* and *Chipknip* concerns the codes for loading the purse. *Chipknip* users could use their (on-line debit) PIN code; *Chipper* users had to learn an extra code. *Postbank* clients had the option to choose this code themselves, so that they could more easily remember it, with however the restriction that this code was not identical to their PIN code. Therefore, two different codes remained.

Moment and speed of technology introduction

The competing banks tried to introduce their chipcards and related technology as quickly as possible. The *Postbank* had to add all kinds of hardware and software to *KPN Telecom*'s telephone network in order to create a payment infrastructure.

The *Chipknip* was distributed in September 1996. The *Postbank* started the distribution of the *Chipper* in May 1997, but the first *Chipper* terminals were not certified by the Dutch National Bank until January 1998. From October 1997 onwards, *Chipper* loading was possible via special telephones at home. The phones were to be used as a reloading device for the *Chipper* and to make payments from one *Postbank* account to another. By November 1997, there were few point of sale terminals available that could handle *Chippers*; they only handled *Chipknips*, so that *Chipper* owners could hardly use their card. The installed base of both cards is presented in Table 1. It shows that the *Chipknip* banks were earlier in providing their clients with cards and were more successful in offering pay points. The number of *Chipper* pay points included 20,000 public pay phones. June 1997, however, *KPN Telecom* agreed with the *Chipknip* banks to create the possibility of using *Chipknips* to pay telephone calls in all 20,000 public pay phones. In August 1999, paying with an electronic purse was possible in 64 percent of all shops; 56 percent of these accepted both cards, 8 percent only the *Chipper*, and 36 percent only the *Chipknip.* The *Chipper* had a better position in the number of public reload points.[1] Moreover, the *Chipper* was earlier in providing tools for loading chipcards at home using the telephone network.

Installed base of *Chipknip* and *Chipper* in the Netherlands at the end of the year, period 1995 – 1999.						
	Chipknip			*Chipper*		
Year	Cards	Pay points	Public recharge points	Cards	Pay points	Public recharge points
1995 (Arnhem)	50,000	1,000	100	-	-	-
1996	2,000,000	48,000	3,000	-	-	-
1997	8,238,417	105,401	6,725	1,000,000	30,000	20,000
1998	12,665,749	141,958	7,015	5,500,000	50,000	20,000
1999	13,400,000	143,947	7,086	7,000,000	80,000	18,500

Table 1: Installed base of *Chipknip* and *Chipper*.

Retailer alliances

Electronic purse and loyalty programs are expected to reinforce each other. Both aim at strengthening customer relations. Therefore, the *Chipknip* as well as the *Chipper* group of banks tried to form alliances with retailer organizations to combine their chipcard with retail-loyalty functionality. Alliances with retailers may just concern the installation of POS terminals, but may also concern the equipment of electronic purses with retailers' loyalty programs. Just supplying retailers with POS terminals was easier for the *Chipknip* banks, because their market penetration in the retail sector was much greater than that of the *Postbank*. The chronological case description shows many attempts and even agreements, but most of these were not implemented. December 1999, only a few were really operational.

Joining forces again

The *Postbank* switched their strategy of competition into one of co-operation in January 1998. It was allowed to do so because *Postbank* was still a member of *Interpay*. They met the other banks and agreed on shared usage of reload points. So the *Postbank* no longer needed to develop a separate proprietary network for the *Chipper* and the *Chipknip* acceptor network compensated the lack of installed base. Ever since, the battle shifted from specifications to price and added extras. For charging the cards, two different circuits remained. However, the double monthly subscription fees (NLG 15 per subscription) still formed a stumbling block for coming to a final agreement in April 1998.

In 1998, the banks also agreed on reciprocal use of their cash dispensers. A technical link between the two infrastructures enabled this. This was made possible through *Interpay*. The *Chipper* and *Chipknip* consortia could continue to offer differences in the area of multi-functionality of the cards.

The two alliances finally agreed on a covenant on March 29, 1999. All 120,000 POS terminals should be modified to handle both cards by the end of 1999. They agreed on the division of costs of 'several million guilders'. Different systems for loading cards should continue to exist till European-wide solutions would become available. The alliances agreed to co-operate in promoting chipcards. They also agreed on one subscription per POS terminal, but did not agree on the monthly tariffs. At that point, both alliances did not charge any subscription fee in order not to create obstacles for merchants wanting to install POS terminals.

Since their agreement, electronic purse use in the Netherlands has gradually grown, especially in contract catering, but apparently not enough: March 5th 2001 the *Netherlands Bankers' Association* (NVB) announced that in the early part of 2002 all *Chippers* will be replaced by new cards that use *Chipknip* technology, and there will be one common technical infrastructure. The banks expect this agreement will stimulate electronic purse use, which will facilitate the Euro conversion.

Case analysis

This section analyses the evolution of the chipcard market from the perspectives of standardization theory and game theory. Both turn out to be valuable for understanding this market. We start with the decision to introduce the *Chipper*. Subsequently we will address the different moves by the two parties and the various possibilities regarding the evolution of the market.

The decision to withdraw

An important aspect of the chipcard market is that there are various parties involved in the standardization process and that there is uncertainty regarding the technology and the acceptance of customers. The multiplicity of parties on the supply side entails that a decision by a particular party will not only have an effect on this party, but also on the other party. It will result in moves and countermoves and in anticipating the response of the other parties. The tool of non-cooperative game theory is geared towards analyzing such decisions.

Game theory is a mathematical method for analyzing multi-person decision situations. Cooperative and non-cooperative game theory are distinguished. Cooperative game theory analyses strategic situations in which it is assumed that the agreements between parties are binding. It has only two ingredients: players and payoffs. Many outcomes of a game are possible. However, only outcomes that satisfy certain requirements are called equilibrium outcomes. Major applications of cooperative game theory are the power in coalitions and the allocation of joint costs. Non-cooperative game theory is more fundamental than cooperative game theory because it investigates which agreements will be established. A non-cooperative game has five ingredients: players, choices, payoffs, information structure, and rules of the game. The addition of choices, information structure and rules of the game provide many possibilities for analyzing strategic processes and institutional features. Non-cooperative game theory will be used to analyze the various decisions in the Dutch chipcard market.

The representation of the Dutch chipcard market as a non-cooperative game requires the specification of the five ingredients. The decision of the *Postbank* to install the new technology depended on their perception of the willingness of the market to adopt the new technology. Uncertainty is modeled in game theory as a move by an artificial player called Nature. It decides with probability p that the circumstances for a chipcard with high functionality are favorable and unfavorable with probability 1-p. The Postbank decides subsequently about introducing the *Chipper*, without knowing the decision by Nature. Figure 1 presents these two players, their choice possibilities, the information structure, and the sequence of decisions (rules of the game). The oval depicts that the *Postbank* does not know whether the market circumstances will be favorable or unfavorable when it has to decide. The next section will outline that the subsequent development of the market entailed many more decisions, but that these decisions were all rather obvious, given the decision to introduce the *Chipper*. The subsequent section pays additional attention to the uncertainty regarding acceptance by the customers.

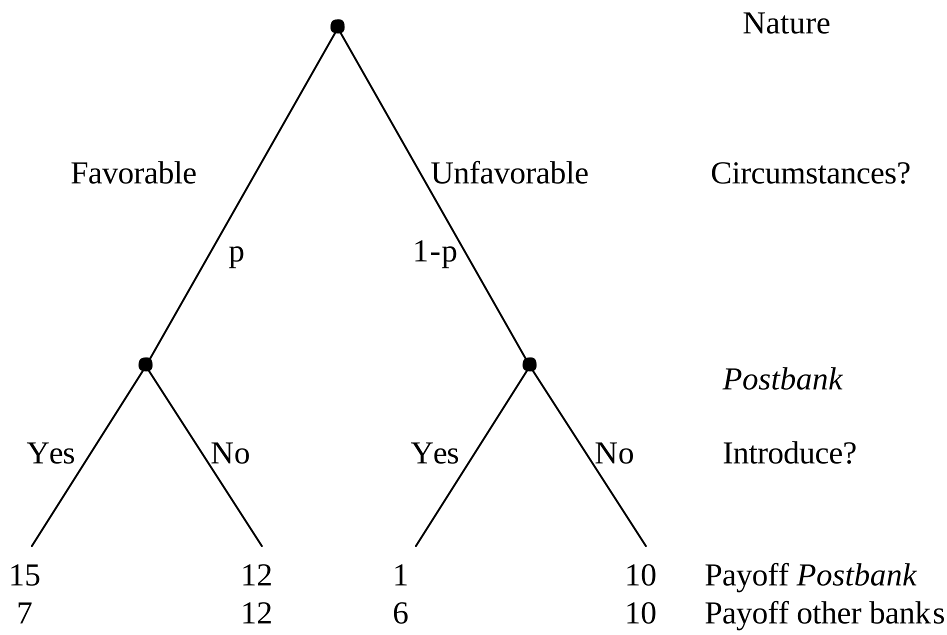

Figure 1. The chipcard game

The final ingredients are the payoffs. The actual level of the various payoffs cannot be based on financial data due to insufficient availability. However, this is not a problem for our analysis because only the difference between the various payoffs is important. We will now outline why the numbers in Figure 1 are representative of the detailed description of the chipcard market in the previous section. An important consideration in the decision by the *Postbank* regarding the introduction of the *Chipper* was its access to a superior technology. This would provide the opportunity to build up a dominant design position. This is represented in the payoffs in the following way. If the circumstances are favorable and the *Postbank* decides to introduce the *Chipper*, then the *Postbank* earns 15 and the *Chipknip* banks earn 7. The payoff 15 reflects the fact that the introduction of the *Chipper* will result in increased market share in payment traffic. The reason for this is that the superior technology creates a strong dominant design position in a market that is favorable to a chipcard with high functionality. The *Chipknip* banks earn 7. If the market is favorable to the new technology and the *Postbank* does not introduce the *Chipper*, then the market will be split more evenly. Each party earns 12. The joint payoffs 15 + 7 = 22 are less than 12 + 12 = 24 because two cards reduce market acceptance due to confusion among consumers.

If the *Postbank* does not introduce the *Chipper* in an unfavorable market, then each party earns 10. If the circumstances are unfavorable and the *Postbank* decides to introduce the *Chipper*, then the *Postbank* earns 1 and the *Chipknip* banks earn 6. The payoff of the *Postbank* is only 1 because it has incurred various costs in making the advanced chipcard available and the demand for this card is low. The *Chipknip* banks have a joint payoff of 6. The joint payoffs 1 + 6 = 7 are less than 10 + 10 = 20 because the introduction of the *Chipper* starts an expensive battle for market share in terms of the number of selling points, the duplication of development costs and installing equipment, and too much innovation. All these moves could be incorporated in the above Figure after the introduction decision of the *Postbank* in a market with unfavorable market circumstances. However, this is postponed to section 4.2. It does not add much insight beyond the observation that the two parties ended up in a destructive prisoners dilemma, i.e. the choice of each party is in line with its own self-interest, but the resulting payoffs for the parties together is less than what is possible in the market.

What can be said about the decision of the *Postbank* to introduce its own card? The Nash equilibrium of the game will be computed in order to address this question. We will compare therefore the expected payoff to the *Postbank* if introducing its own card with the payoff of not introducing its own card. It is profitable for the *Postbank* to introduce its own card when $15p + (1-p) \geq 12p + 10(1-p)$, i.e. $p \geq 3/4$. The *Postbank* took the right decision when $p \geq 3/4$ given the available information, i.e. the importance of introducing the *Chipper* under favorable circumstances outweighs the costs of introducing the *Chipper* under bad circumstances. A probability $p \geq 3/4$ seems relevant given the successful project of the chipcard in the city of Arnhem and the additional functionality made possible by the co-operation with *KPN Telecom*. We notice that this does not guarantee that the introduction of the *Chipper* will be a success for the *Postbank*. It is probabilistically possible that the introduction decision has been taken under unfavorable market circumstances. This is inevitable when there is incomplete information. It does not imply that the *Postbank* has taken ex ante the wrong decision. It was just bad luck that this possibility has emerged, given that the introductory market of Arnhem was considered to be representative for the rest of the country. Formally, the decisions of the *Postbank* may have been ex-ante correct given the available information, but they turned out to be a mistake ex-post when the uncertainty was resolved.

However, the representativeness of Arnhem may be questioned to a certain extent, because the *Postbank* is a major employer in Arnhem. This may have favored adoption. The available data does not reveal to us whether this effect had been taken into account in the decision-making to introduce the *Chipper*.

Dominant strategies and the prisoners' dilemma

Figure 1 has presented one decision by one party in the standardization process. This is, of course, an extremely simplified account of the chipcard market. However, we will argue in this section that many of the subsequent decisions in the chipcard market were obvious, despite their destructive character, once the *Chipper* had been introduced. In other words, several choices by both banks could be added to the branch 'Unfavorable – Yes' in Figure 1, but the outcome is adequately summarized by the prisoners dilemma outcome with a payoff of 1 for the *Postbank* and 6 for the other banks.

The *Postbank* had two important arguments for its decision to withdraw. First, it had a larger number of reload points thanks to the alliance with *KPN* and, therefore, had superior technology. The alliance with *KPN* enabled the *Postbank* to use reload points everywhere in the country (via the public pay phones) and, after some time, in almost everybody's home (via private telephone). Second, the *Postbank*'s strength was in its ability to add multi-functionality. It had access to the knowledge of *KPN Research* and the experiments with multi-functional cards. Apparently, the *Postbank* expected the *Chipper* to be a dominant design that would be bandwagoned because of superior functionality. The first advantage was diminished when the competing alliance also offered tools to charge the *Chipknip* at home. Additionally, most people that should have used the chipcard were accustomed to getting cash at automatic teller machines. *Chipknip* reload points were placed next to these. Additionally, the telephone network advantage diminished when *KPN Telecom* lost their monopoly. Competing telephone companies entered the market. However, the only implemented *Chipknip* application concerned paying in 1200 *Telfort* public pay phones. Finally, *KPN Telecom* decided to allow the *Chipknip* banks to also use their card for payments in public phones.

The value of the second advantage can be also questioned. There are several reasons why it can be expected that consumers hardly pay any attention to the technology in the chipcard market. First, a special form of *conversion costs* is related to the PIN codes of the cards of the *Postbank*. *Chipknip* users can use their debit card PIN code; *Postbank* clients have to learn a new PIN code for their *Chipper*. This was done for reasons of safety but may hinder the card's use – a disadvantage that might influence holders of both chipcards in favor of *Chipknip* use. The disadvantage of an extra PIN code may outweigh the technical advantages of the *Chipper*. Second, the technical sophistication also did not really matter for the retailers, as long as it was not attractive for them to add loyalty programs or client card functionality. Third, the superior functionality of the *Chipper* disappeared when the *Chipknip* banks introduced a new chip for their card.

The *Chipknip* group of banks had a *first-mover advantage* regarding availability, which may have been the crucial factor in the failure of the *Chipper*. There were at least two factors that enhanced or, at least, did not weaken this position.

First, the majority of the retailers carry out their financial business with one of the *Chipknip* banks. Although retailers may have several banking accounts, they, in general, have one bank for most financial services. It takes effort to shift to another bank: they are *locked-in*. This hindered the *Postbank* in establishing alliances with retailers in order to install POS terminals / pay-points and/or to use the *Chipper*'s functionality for retail loyalty programs. This explains why an initiative by *ING Bank Nederland* to offer combined *Chipper/Chipknip* POS terminals did not achieve a breakthrough – retailers did not change their bank for such a tool.

Secondly, many consumers have accounts at different banks. In general, they use one of these for most of their daily payments. In this segment, the *Postbank* has a good position. Electronic purses are tools for these services. However, once people have chosen a bank for their payments, they tend to stay there (*lock-in*). The choice between *Chipper* and *Chipknip* is subordinate to that. And people will not take an account at the *Postbank* just because of the *Chipper*: conversion costs do not exceed the advantages of the *Chipper* to the *Chipknip*, if any.

The decision to introduce the *Chipper* was followed by various strategic moves. The war between the two standards involved publicity campaigns, strategic alliances, and price cuts. It resulted in a lack of acceptance of the technology as such. Moreover, compared with a situation with one standard, lots of extra costs were made, not only by the *Postbank* who left the common chipcard initiative, but also by the other banks.

The *Chipknip* banks were losers, too, because the battle hindered market acceptance and the 1999 covenant to create a common infrastructure for two different cards caused lots of conversion costs. So, they would probably have profited more if they had accepted the offer to participate in the *Chipper* project, despite all the preparations that were made for the introduction of the *Chipknip* and despite all the uncertainty surrounding the *Chipper* initiative.

The decision to modify POS terminals and related infrastructure for use of both cards is in line with standardization theory: in a market with network externalities and competing compatibility standards, the theory indicates that a gateway technology which bridges the two incompatible technologies is the preferred solution. A gateway technology establishes compatibility between non-compatible systems. This is what happened: POS terminals for combined *Chipper* and *Chipknip* use. It might be expected this would enhance technology acceptance. During 1999, chipcard usage almost doubled, 2000 showed further growth.

However, apparently this growth was less than the banks had expected. Most growth concerned applications where the consumers had no choice anymore to use coins: parking and contract-catering. In ‘voluntary’ applications, such as chipcard use in shops, there was little growth. Moreover it was costly to maintain and extend an infrastructure suitable for two cards. Probably these were the considerations to decide, finally to one card and one infrastructure: back to square one.

All these decisions by each chipcard group were rational, given the situation that had emerged. However, they entailed a very costly prisoners dilemma for the parties involved. The question arises of why the banks went into this destructive prisoners dilemma and how events could have evolved in a different way. This is the topic of the next section.

Competing standards and market evolution

Competing standards differ in the advantages they generate for different categories of users. Each may get its own installed base. Subsequent *lock-in* effects and *bandwagoning* may prevent one of them from winning. This is relevant in our case, because some people only have a *Postbank* account, whereas others have no *Postbank* account at all. People who have two accounts may be expected to prefer the chipcard related to the bank account they already use for daily payments. So, in this case, despite all drawbacks, a situation with two competing standards was a real option.

Competing standards may cause market and buyer uncertainty. In our case, the standards battle may have been a reason for the slow penetration of the electronic purse in the Netherlands, whose situation will be compared with the one in Belgium in order to investigate this claim. This comparison seems appropriate because the payment structure and habits are similar in both countries, the number of inhabitants does not differ too much (Belgium: 9,000,000, the Netherlands: 16,000,000), and number of merchants is comparable (Belgium: 300,000, the Netherlands: 240,000). Table 2 and 3 present the comparison between the Belgian chipcard *Proton* and the two Dutch cards.

Project	*Proton*	*Chipknip*	*Chipper*
Nationwide start	1996, 2nd quarter	1996, 3rd quarter	1997, 2nd quarter
Cards issued	900,000	2,500,000	225,000
Number of purchasing terminals	6,955	35,000	20,000
Number of loading terminals	1,450	4,000	18,000
Number of transactions per month	500,000	80,000	0
Average amount per transaction	BEF 218 (≅ 5,40 Euro)	NLG 15 (≅ 6,80 Euro)	NLG 14 (≅ 6,35 Euro)

Table 2: Belgian and Dutch Electronic Purse projects, data 97-01-31 (European Committee for Banking Standards, 1997)

The general tendency is that there is more card use in Belgium in spite of fewer cards, POS terminals and loading terminals. In Belgium, the card project was co-ordinated by *Banksys*, an organization of banks responsible for electronic funds transfers. The cards were used as *Belgacom* calling cards and will soon be used for internet payment, for a variety of loyalty schemes, and for electronic benefits transfer to social security recipients (Birch, 1998). The number of Dutch electronic purse transactions, 80,000, at that moment was far less than the Belgian 500,000, in spite of the fact that the Dutch issued many more cards, and installed many more terminals. The data offered by *Proton World* (for *Proton* and *Chipknip*)[2] and *Chipper Nederland* for 1999 is presented in table 3.

Project	*Proton*	*Chipknip*	*Chipper*
Cards issued	7,300,000	14,000,000	7,000,000
Number of purchasing terminals	61,000	145,000	80,000
Number of loading terminals	69,000	6,700	18,500
Number of transactions since launch	82,000,000	23,000,000	21,100,000

Table 3: Belgian and Dutch Electronic Purse projects, data 99-12-31 (Sources: websites, personal communications).

The difference in the number of loading terminals is due to the fact that the Belgian number includes (private) home terminals, whereas the Dutch number concerns public terminals and the number of *Chipknippers* and *Chipper* tools for home loading is not included. At the end of 1999, there were more than 5000 tools for *Chipper* loading at home via the telephone network. There is a problem in comparing the *Proton* data on the number of *Proton* and *Chipknip* transactions with the actual number of *Chipper* transactions. According to *Chipper Nederland*, *Chipknip* use exceeded *Chipper* use (market share approximately 60 percent versus 40 percent or 2/3 versus 1/3). This would mean the total number of Chipknip transactions since launch to be around 40,000,000 or a little more. Obtaining trustworthy data remains a problem, but it can be concluded that at the end of 1999, Belgian chipcard usage exceeded that of the Dutch.

Comparison with Table 2 shows a considerable increase in card use in both countries, but the Belgian lead remained. So its seems plausible that the standards battle affected the use of the technology. This opinion was shared by the president of the Dutch national bank, Mr. Wellink and by *Proton World*'s Product Communication Officer, Mr. C. Bourne, who wrote in a personal communication: "The general view of the Dutch situation is that the two competing schemes confused the cardholders and hindered the development of both." Notice that these observations are reflected in the payoffs in Figure 1. If the competing *Chipper* is introduced, then the joint payoffs are lower, regardless of the circumstances.

The experience with one chipcard in Arnhem may not have been informative for markets where there would be more than one chipcard standard, i.e., the *Postbank* may have been too optimistic about market demand. This may have made the difference between introducing and not introducing the *Chipper* and subsequently a payoff of 1 instead of 10 for the *Postbank* when market circumstances turned out to be unfavorable.

Summary and conclusions

We have described and analyzed the banking chipcard market in the Netherlands. The outcome of the standards war was not obvious when the *Postbank* introduced its *Chipper*. One standard for banking chipcards is in general the best option from the viewpoint of market acceptance of the technology, economies of scale and network externalities. Yet, the *Chipper* was introduced: a second chipcard standard. It aimed at becoming a dominant design due to better functionality. However, it failed in getting the lead in market acceptance. There are several reasons for this failure. First, most retailers have *ABN-AMRO* or one of the other banks as their home bank. This hindered forming alliances with retailers willing to use the card and/or to add extra functionality to the card. Therefore, the *Postbank* could not profit from its competitive advantage of better card functionality. Second, the *Chipper* had technical and production capacity problems. Third, the *Chipper* banks had to pass a certification procedure from the Dutch National Bank, which caused extra delay.

Standardization theory as well as game theory have been used to analyze the Dutch banking chipcard market. Standardization theory posits mechanisms for market success of standards. Several mechanisms may point in different directions (Lee at al., 1995). The concept of a *dominant design* points for the *Chipper* to win due to better functionality. However, all other concepts, such as the one of *first mover* favor the *Chipknip*. It turned out that for a long time none of them won as both cards were related to the *installed base* of bank clients. Neither retailers or consumers changed bank preferences just because of cards – they were *locked in*. Because none of the banks withdrew their chipcard, this lock-in resulted in a situation of two competing chipcards, each with its own installed base. This situation of incompatibility was after some time resolved by the choice of a common *gateway technology*. Finally, the disappearance of the *Chipper* was announced in March 2001. The press release stated that the banks expect to see an increase in the usage of the electronic purse.

Game theory pays attention to the possible moves of the competitors and the available information. Game theory adds uncertainty and the dynamics of developments over time to the more static analysis of standardization theory. It was shown that the *Postbank* had a real chance of winning, provided that the market favored multi-functionality. The introduction of the *Chipper* started a battle for market share, which was expensive for all parties involved. After a year it was clear the *Postbank* would not win. The market had not embraced multi-functionality, the *Chipper* banks were not able to introduce their technology in time, and the *Chipknip* banks had upgraded their card to arrive at comparable functionality. At that moment, the *Chipper* banks could have decided to stop their *Chipper* project and return to the *Chipknip* alliance. However, they did not. It took a few more years to end the destructive prisoners' dilemma between the two groups of banks.

This case and its analysis may be informative for parties involved in strategic choices related to the introduction of new technologies in markets characterized by network externalities. A number of lessons and ideas for future research emerge from this study. First, the destructive development of the Dutch banking chipcard market may facilitate co-ordination and stress the importance of one chipcard standard in other chipcard markets. Two standards may be feasible, but it is crucial for the various parties that only one standard is implemented. The expensive experience in the Netherlands may deter the implementation of two standards in other countries. Second, we have argued that the withdrawal decision of the *Chipper* group of banks was not a self-evident mistake, given the available information. Third, the importance of having one standard together with understanding the destructive prisoners' dilemma which emerges when two standards are implemented, may result in advice and institutional restructuring which prevents, or at least shortens, destructive standards battles. For example, the attempts to establish initially an agreement on one standard may have failed due to the mechanisms that were proposed for the division of the benefits of having one standard. The involved parties may have underestimated the importance of the development of a scheme that allocates the benefits of one standard in a fair way. Fourth, cases regarding competing standards usually stress the choices that are available to potential users. However, decisive in this case was the subordination in choice of technology to the loyalty to the provider (bank) and its portfolio of products and services. As argued by Koehorst, De Vries and Wubben (1999) it is necessary to relate the decision to standardize to its technical environment and to all the stakeholders related to that. This especially applies to the complicated interrelations characteristic of the new economy.

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[1] These data come from consumer organization *Consumentenbond*; according to the Netherlands Bankers' Association (NVB) these data do not reflect the real situation. However, the NVB does not make its data available.

[2] The Belgian *Proton* and the Dutch *Chipknip* use the same technology, but the cards are incompatible. Both the Belgian and the Dutch organization are members of *Proton World*.

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