Size Matters:
Economies of Scale in the European Payments Market

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Abstract

This thesis investigates the existence and extent of economies of scale in the European payments processing industry. SEPA aims to facilitate the emergence of a competitive, intra-European market by making cross-border payments as easy as domestic transactions. It is expected that SEPA will spur consolidations and mergers among European payments processors to more fully realize economies of scale. We find evidence for the existence of significant economies of scale using data of eight European payment processors during the years 1990-2005. This thesis also reveals that ownership structure is an important factor to explain cost differences across European Automated Clearing Houses (ACHs).

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This research was carried out during my internship at the Economics and Research Department of the Nederlandsche Bank in the period October 2006-April 2007. I would like to thank Job Swank and Wilko Bolt for their valuable suggestions, they have been encouraging supervisors. Special thanks go to Corry van Renselaar for her valuable contribution during the progress and completion of this thesis. The usual disclaimer applies.

Contents

1. Introduction

European payment markets are subject to intense and rapid transformation. After the introduction of euro banknotes and coins in 2002, the European Commission (EC) aimed at further integration of European retail payment markets. European payment markets are still highly fragmented, making cross-border payments inefficient, expensive and time consuming. European citizens will only fully benefit from free movement of goods and services if they are able to transfer money and make payments within Europe as easy and cheaply as in their own countries. The creation of a Single Euro Payments Area (SEPA) will contribute to the completion of the Single Market. In this light, SEPA is defined as: 'a euro area in which all payments are domestic, where the current differentiation between national and cross-border payments no longer exists'.[2]

Payment markets are complex and their integration even more. To create SEPA, domestic payment standards, infrastructures and jurisdictions need to be harmonised. The EC recognised that a spontaneous integration was not likely to occur. In providing payment services, banks must compete and cooperate at the same time. Therefore, the EC implemented a Regulation to force the banking industry to integrate their payment systems and infrastructures. With the advent of SEPA, domestic payment markets are opening up. It is expected that SEPA will boost competition and that it will spur mergers and consolidations among European payment processors to fully realise the potential economies of scale.

In this thesis, we first describe some major trends in the European payment market and characterise the market structure. Second, we investigate whether economies of scale exist for the European payment processing industry, and raise the question by how much payment costs may fall as a result. Furthermore what is the impact of SEPA on the structure of the European payment processing market? Would only a few players survive or could it even lead to a natural monopoly. Would that be a social desirable outcome or does it call for some form of competition policy regulation?

At present, only a few studies exist that particularly deal with economies of scale in European payment markets. This thesis contributes to this literature by estimating payment scale

[2] ECB, towards a Single Euro Payments Area. Objectives and Deadlines (4th progress report).

economies for the European payment industry, using a unique data set compiled of eight European payment processors over the 1990-2005 period.

This thesis is structured as follows. Chapter 2 describes the background and goals of SEPA. Chapter 3 analyses the market structure of the payment processing industry and recent developments of payment usage. Chapter 4 estimates economies of scale in the European payment market. Chapter 5 concludes and elaborates on policy implications.

2. The Single Euro Payments Area

This chapter aims at describing the key events that have contributed to a Single Euro Payments Area (SEPA). The idea to create SEPA finds its origin in the realization of the Economic and Monetary Union (EMU) and the introduction of the euro in 1999. EMU aims at eliminating the barriers hampering the free movement of trade and goods across the European Union (EU). A particular objective was to create a single homogeneous market where currency would move as freely and cheaply in the Euro zone as it had previously within national borders. It is obvious that a Single Euro Payments Area is highly instrumental to that goal. The aim is to create an area where European citizens, companies and other economic agents will be able to make and receive payments in euro regardless of their location, whether between or within national boundaries under the same basic conditions, rights and obligations, regardless of their location.

At the moment, the European payment market is still highly fragmented. Cross-border transactions are expensive and execution time is long. A spontaneous harmonisation of the fragmented payment systems by the banking sector did not occur. Therefore, the European Commission implemented directives and regulations to put pressure on the banking industry to cooperate and harmonise their systems. In March 2005, the banking industry committed itself to making SEPA a reality by the end of 2010.

The structure of this chapter is as follows. The first section describes the underlying ideas of the European Commission to create an internal market. The second argues why integration has been so difficult. The third discusses the efforts of the EC to integrate the payment market. These sections are followed by a description of the forces which kept the banking industry reluctant to cooperate. In the final section SEPA is defined, and the framework that has been designed for the payment infrastructure will be described.

2.1 Paving the way

The origin of a Single Euro Payments Area dates back to 1951, when the European Coal and Steel Community (ECSC) was established and the idea of an internal market was born.[3] The aim of the ECSC was to contribute, through a common market for coal and steel, to economic

[3] The Treaty was signed by France, Germany, Italy, the Netherlands, Belgium and Luxembourg.

expansion, growth of employment and social welfare. The political driver was to strengthen the solidarity between countries and pave the way for European integration.

Since 1951, political and economic European integration has deepened immensely and a growing number of countries joined the European Union. The Single European Act of 1986 was a big step towards a unified European market. It became reality in 1992, and was defined, in the Treaty of Maastricht, as an ‘area without internal frontiers, wherein the free movement of capital, goods, services and people is ensured’. One of the objectives was the foundation of an Economic and Monetary Union (EMU). The overarching objective of EMU was to create a common currency, the Euro, and the establishment of a European Central Bank (ECB). In 1999, the Euro was introduced, which diminished exchange rate risks and increased price transparency within Europe. Euro coins and notes were introduced in 2002, giving birth to the first joint payment instrument.

An efficient European payment system is of vital importance to the smooth functioning of the Single Market. It will be the finishing touch of the internal market. After all, a truly free movement of persons, services and goods will only be possible if cross-border payments in euro can be made in just the same easy way as domestic payments.

Already in 1990, the European Commission published a paper ‘Making Payments in the Internal Market’, expressing its view on the urgent need of a common payment market. Despite the efforts of the EC to integrate the payment market through consultation papers and directives, harmonisation failed. A natural harmonisation of the payment markets by the banking industry did not occur either.

2.2 Fragmented payment systems

The main source of inefficient cross-border payments is the existence of different domestic payment systems and standards within Europe. Payment systems are like plug-sockets. American and European standards diverge. An EU hairdryer for example does not work in the US or the other way round, unless a transformer is used. Similar difficulties apply to the European payment market.

The highly fragmented European payment market can be explained by so-called ‘path dependence’, ‘lock-in’ and network effects. Theories dealing with these phenomena are widely discussed in the economic literature.[4] In general, path dependence is described as economic progress in line with new technologies. It leads to new payment systems and instruments that deliver more benefits at lower costs. If, at some point, critical mass has been established, payment instruments and systems will be standardized, and countries are locked-in their own payment habits. When locked in, it becomes hard to leave the 'path' and to adopt more advanced technologies over time. This development has been intensified by the fact that most payments transactions occur within national boundaries. The problem is that domestic payment systems can be very efficient whereas, at the cross-border level, national systems are incompatible, causing inefficiencies.

European payment systems differ. First, different standards are used within Europe to characterise payments. For example, an account number in the Netherlands consists of 10 numbers whereas in Italy 12 numbers and a specific bank identifying code is used. The exchange of cross-border payments therefore often requires manual processing, leading to high costs. Account number portability remains a difficult cross-border issue.

Second, the organisational infrastructure of processing systems varies. Most European countries have automated systems to process payments, so-called Automated Clearing Houses (ACH). An ACH is a centralised platform which sorts and clears large volumes of payments between member banks. ACHs are often owned by commercial banks. In order to counteract restricted membership, in some countries, ACHs are managed by the National Central Bank (NCB) and membership is open to all banks. Other countries process payments mainly through correspondent banking, made possible by bilateral agreements between banks. Smaller banks that have no internal processing facilities, hook up to large banks which handle payments on their behalf. In order to get full geographical coverage, many bilateral agreements are needed. Clearly, high costs are incurred and execution time may be long.

Third, national legislation surrounding payments is a major hurdle for the exchange of cross-border payments. Especially, rules concerning dispute settlement of direct debits differ among countries. [5]

To summarize, European payment systems and standards are virtually incompatible and until recently no pan-European payment system existed. As ACHs operate mainly on a national basis, the correspondent banking model dominates the execution of cross-border payments.

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[4] See for a comprehensive discussion, Leibbrandt, G. (2004) and also Kemppainen, K. (2006).

[5] A direct debit is a payment instrument where the payer authorizes its bank to monthly debit an amount of money of the former's bank account in favour of the receiving party (for example the monthly).

2.3 EC efforts to harmonise the payment market

As mentioned, in 1990 the European Commission proclaimed the urgent need of a common payment market. The focus of a first discussion paper was on retail cross-border payments.[6] Anticipating on intensifying European integration, citizens and Small and Medium Sized Enterprises (SMEs) needed to be able to exchange payments efficiently. The EC focused on credit transfers, because at the time they were processed both manually as well as electronically by national ACHs. In order to process cross-border credit transfers more rapidly and less costly, the EC proposed to link the domestic ACHs, ultimately leading to a Pan-European ACH (PEACH). Linking ACHs would complement the growing use of electronically processed payments, and EU standards could be developed to enable faster processing.

The EC stated its view on the creation of a common payment market very clear. The Commission realized that the development of such a market would not evolve naturally. It would require the cooperation of the banking industry accompanied by regulatory action by the EC itself. Between 1992 and 1997, the EC conducted studies on the efficiency of cross-border EU payments in terms of costs and execution time. The results showed that the average cost of a cross-border payment was EUR 24 for a transfer of EUR 100. A cross-border credit transfer took on average 4.8 working days; over 15% of the payments took more than one week to be executed.[7] The EC was dissatisfied with these results and issued a Directive in 1997. This Directive laid down the rules for more transparency and focussed on the performance of cross-border payments. It was implemented in 1999. Despite the Directive, cross-border payments persisted to be more expensive and time consuming than domestic payments.

Following the successful conversion to the euro in 1999 and with the introduction of euro notes and coins in January 2002 ahead, the EC raised pressure on the banking industry. EU citizens, corporations, SMEs and public authorities were still not able to shop around for the most efficient payment service provider. The EC became increasingly frustrated and acknowledged the Directive to be too weak to drive the banking industry towards action. It issued a Regulation.

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[6] Commission of the European Communities (1990), Making Payments in the Internal Market.
[7] ECB (1999), Improving Cross-border Retail Payment Services the Eurosystem's View.

This Regulation was more powerful than a Directive. It stated that if a Member State did not comply, a penalty of effective, proportionate and deterrent sanctions would be taken. The Regulation was implemented in December 2001. Banks were compelled to charge the same fees for cross-border payments (electronic payments transactions and credit transfers) as for national payments. The Regulation also forced the banks to implement a common account numbering system (IBAN) and reduced the execution time of credit transfers to three working days.[8]

2.4 A resisting banking sector

Why did the banking industry stick to their own payment infrastructures? Banks face major changes with the realization of a common payment market. The harmonisation of domestic payment systems requires large investments in infrastructures, new standards and technologies to make payment systems within Europe compatible.

Traditionally, in most European countries the banking sector has been highly concentrated and payment processors often operated in duopolistic or local monopolistic markets. In the new European payment landscape, payment service providers must cooperate ànd compete at the same time, causing a natural economic tension. How can a bank develop new standards and payment instruments knowing its rivals all over Europe may benefit or steal its business away?

Nonetheless, persistent political pressure and the threat of substantial revenue and market share losses triggered the banking industry to take action. The creation of a common payment market is irreversible. There is no other option for the banking sector than to cooperate. In 2002, large banks and banking associations committed themselves to create a Single Euro Payments Area. The European Payments Council (EPC) was established to carry out the project.

2.5 SEPA

SEPA is defined as ‘a euro area in which payments are domestic, where the current differentiation between national and cross-border payments no longer exists’.[9] The

[8] Regulation (EC) No 2560/2001 of the European Parliament and of the Council of 19 December 2001 on cross border payments in euro.
[9] ECB (2006), Towards a Single Euro Payments Area – Objectives and deadlines (4th Progress Report).

liberalisation and harmonisation of national payment markets will lead to intensified competition, the standardisation of payment instruments and their underlying systems to result in consolidation. The most important economic driver is that competition at a European level playing field in combination with consolidation is expected to allow for substantial economies of scale. This should put a downward pressure on payment transaction costs.

Credit transfers, direct debits and card payments will become the first collectively European payment instruments. EPC has defined the standards for the instruments as well as a framework for the underlying payment infrastructures.

SEPA will have an impact on European society. However, to guarantee its success, SEPA entails efforts of all stakeholders in the payments market. The banking industry needs to invest in new payment systems and technologies, public authorities need to move en masse to those systems and Europe's citizens need to change their payment behaviour.

SEPA will not be created overnight. At the end of 2010 at the latest, European citizens will exclusively use SEPA payment instruments. If SEPA becomes a success, economic agents may benefit from faster, easier and cheaper payment possibilities. If successful, SEPA may contribute to a more competitive Europe and social welfare might increase in terms of economic growth.

2.6 An ACH Framework: the rules of the game

In order to create a single payment market, the national based ACHs need to be able to process the new defined SEPA payment instruments. EPC has developed a framework in which the rules (and boundaries) of the new ACH market structure are designed. ACHs basically have three options in SEPA: a) become a Pan-European ACH b) become SEPA-compliant and c) quit operations and move all domestic payment volume to a SEPA-compliant or PEACH. A PEACH is a Euro-wide and country neutral clearing organisation, providing reach to all banks in SEPA. To foster fair competition and create a level playing field, public payment providers should be exposed to the same principles that apply to private payment processing providers. [10] To become SEPA-compliant, ACHs must be able to send or receive payments information of SEPA-instruments and standards to and from all banks in the euro area. SEPA compliant ACHs and PEACHs therefore need to be interoperable through direct or indirect linkages between other ACHs.

[10] For details, see the report of the European Payment Council (2006), Framework for the Evolution of the Clearing and Settlements in SEPA.

3. European ACH Industry structure

A pan-European ACH industry is emergent. The development of a European single payment area will open up the payment processing market. Until recently, the processing of payment transactions was basically a domestic matter, and many European countries had only a single payment processing provider. In fact, those single ACHs were often operating in a monopolistic setting and acted as price setters. SEPA is expected to create a European level playing field and national ACHs will be exposed to a new, competitive market environment. ACHs need to anticipate on this new situation and must adhere to a prescribed framework in order to operate within a SEPA environment.

The ACH market is in transition towards a more competitive setting. Some ACHs have engaged in mergers and switched their governance structure from public non-profit to privately owned. The behaviour and interaction of ACHs and the nature of this specific industry are worthwhile studying for several reasons. First, the dynamics of SEPA will lead to a new ACH market structure. Despite increased competition, a potential outcome of this dynamic game is that only a few, or maybe even one ACH will survive, so as to fully realize the potential economies of scale. Second, from a policy perspective, the question arises whether the new configuration of the European ACHs will lead to a social desirable optimum. Furthermore, information about the ACH industry may be useful to formulate policies that strive to ensure the well-functioning of the payment market.

This chapter describes the European ACH industry by a number of stylized facts. It is structured as follows. Section 3.1 briefly sketches the working of the ACH industry. Section 3.2 analyses the supply and demand side and elaborates on recent developments in this industry. Section 3.3 discusses some specific characteristics of payment systems. Section 3.4 concludes.

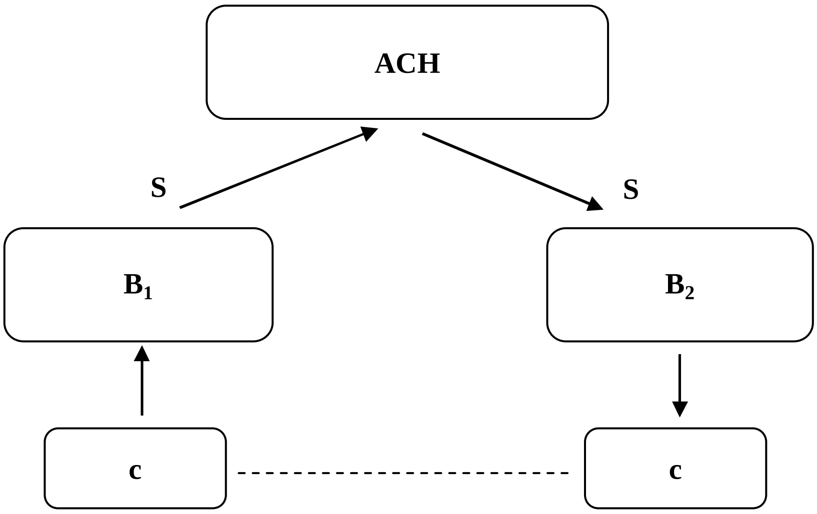
3.1 European ACH industry: some facts

The evolving European market of processing payments is complex to analyse. The complexity of the payment industry lies foremost in its governance structure. This structure makes that the supply and demand side of the market are inter-related. Inter alia resulting in a natural tension between necessary cooperation and effective competition, and the existence of strong network externalities.

Participants in the ACH industry

The principal participants in making a payment are; the payor (the initiating party), the payee (the receiving party), the payor's bank, the payee's bank, and a payment processor (ACH). Figure 3.1 depicts a stylized static presentation of the key participants in the ACH industry.[11]

Figure 3.1 A stylized payment model



The model above illustrates that a payment processor faces demand from several parties. The demand side for processing services can be divided into direct and indirect demand. The indirect demand comes from end-users (*c*) who initially initiate the payment instructions to their bank. End-users do not comprise only of consumers but also companies and government institutions. The ACH then faces direct demand from its participating (member) banks (*B*) that forward the payment instructions on behalf of their consumers to be processed. A typical characteristic of an automated payment processor is that it enables its participants to submit files containing a large number of payment transactions at once, called bulk payments. In this model (see Figure 3.1), companies and government institutions are also able to initiate payment instructions. The ACH then facilitates the exchange of those instructions between all participants. Companies and government institutions are added to the static model because within SEPA, these participants will be able to submit their bulk payment instructions directly

[11] The interested reader is referred to the appendix for a detailed description of the route of a payment. This is described for a domestic as well as a cross-border payment transaction.

to ACHs. In fact, this new target group enlarges the potential market of payment processors. The total demand for processing services in the euro area can be calculated by the number of electronic payments made (indirect demand of consumers). The total volume sums to 45,6 billion electronic payment transactions in 2004.[12] Total demand in terms of potential participating banks in the Euro area sums to approximately 6.500 banks.

3.2 Trends in payments usage: supply and demand factors

On the supply side of this industry, the payment processors facilitate the automated exchange of payment transactions between their participating banks and other members such as companies and government authorities. Figure 3.1 depicts a simplified route of a payment transaction. The interaction between the parties occurs if a consumer initiates a payment instruction to its bank *B1*. Bank *B1* accumulates all payment instructions received during a given time frame and sends them in a bulk payment file to the ACH. The ACH opens the file and redistributes the payment instructions to the receiving bank, in this case *B2*.

Electronic payments: a growing business

Payment processing services provided by ACHs in the Euro area are differentiated. The four basic electronic payment instruments processed by ACHs in Europe are credit transfers, direct debits, card payments and cheques. Annual reports and websites of national payment processors reveal that they also provide additional, country specific, services to their banks.[13] Over the past fifteen years, the use of electronic payments has increased, whereas the use of paper-based payments has declined. Figure 3.2 illustrates the development of the number of used payment instruments in the Euro area.

The figure strongly suggests a substitution towards electronic modes of payments. Using data from 1990 to 2004, clear trends of the various electronic payment instruments are observed.[14] In 1990, cheques started out as a relative popular payment instrument. At the same time a downward trend set in. Credit transfers dominate the use of electronic payments and seem to retain this position. The volume has doubled from 7 billion in 1990 to 14 billion in 2004. The introduction of internet banking seems to be a reasonable explanation for this development.

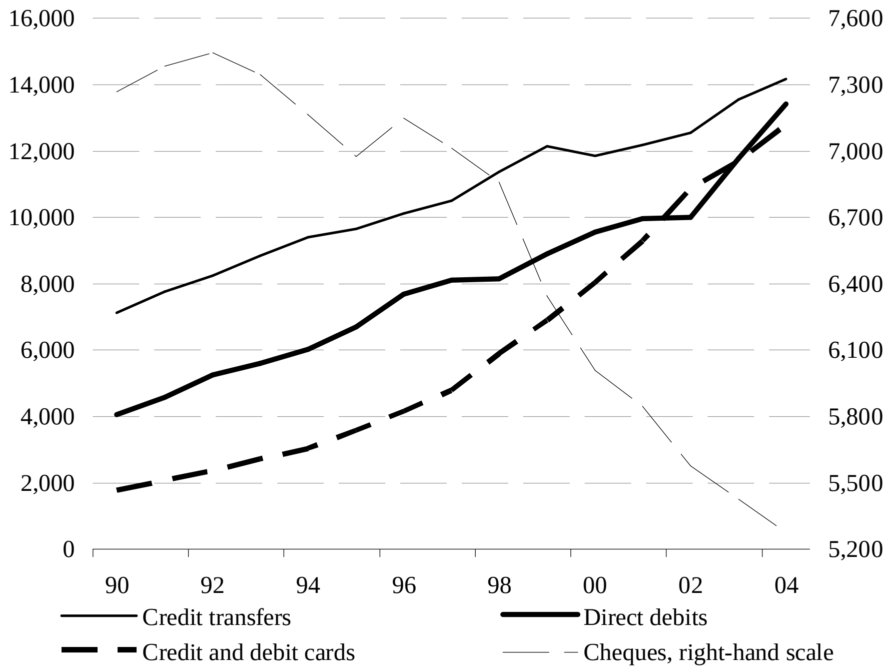
[12] ECB Blue Book (2006).

[13] Additional ACH services can be risk management, balance and transaction information, mandate management and customer support. See Equens Report, ‘Bundled benefits, your payments in future proof hands.

[14] The number of cards includes debit and credit. Totals in figure 1.1 include France, Germany, the Netherlands, Belgium, Portugal, Spain, Italy, Austria, Luxembourg, Ireland, Finland and Greece.

Paying with plastic is popular in Europe. Its volume growth in absolute terms is impressive; 1.7 billion in 1990 to 12.8 billion transactions in 2004. Another interesting development is the steady growth of the usage of direct debits and contributes to the evidence of the substitution process.

Figure 3.2 Development of used electronic payment instruments in the euro area
EUR mln



Source: Bank for International Settlements (Blue Books 1995, 1999 and 2006).

The spectacular growth of electronic payments indicates that processing payments is a growing business. Within SEPA, standards of payment instructions will be harmonised and payments seem to become homogeneous services. The resulting payment processors within SEPA will therefore need to compete on differentiated services, quality and prices.

ACH landscape: Setting the scene

Changes in the European ACH landscape have become visible. The liberalisation of the European payment markets has already forced domestic ACHs to redefine their strategies. Table 3.1 shows some first insights of this dynamic process. The table shows a clear shift in the number of players and their volumes. In 2004, the number of automated payment processors within the euro zone amounted to 14 and has been reduced to 11 players in 2007. The French clearing house (SIT, at present STET) was the largest processor in 2004 and retains its position in 2007. Although Voca is a player of a non-euro country UK, it announced its ambition to become a competing player within SEPA. As a result of concentration in the ACH industry, the volume has been redistributed among the payment processors. In 2004, the market share of the four largest payment processors was 72%, by 2007 it has increased to 76%.

Table 3.1 Payment processors in the euro area
Volume in thousands

Automated Clearing Houses (ACH) 2004				Automated Clearing Houses (ACH) 2007			
Country	Processor	Volume	Owners	Country	Processor	Volume	Owners
FR	SIT	11,6	CB	FR	STET	11,8	B
UK	BACS	4,6	CB	EU	Equens	6,6	B
NL	Interpay	3,1	B	UK	Voca	4,8	B
GE	TAI	2,9	CB	EU	STEP2	3,3	B
GE	RPS	2,2	B	GE	RPS	2,4	CB
IT	BI-COMP	1,8	CB	PT	SIBS	1,6	B
PT	SICIO	1,4	CB	ES	STEP.AT	1,6	CB
ES	SNCE	1,2	CB	BE	Iberpay	1,3	B
BE	CEC	1,1	CB	FI	CEC	1,1	CB
FI	PMJ	505.0	AS	IR	PMJ	505.0	AS
IR	IRECC	295.0	CB	AT	IRECC	300.0	CB
EU	STEP2	28.0	B	GR	DIAS	29.0	CB/B
GR	DIAS	28.0	CB				
LX	LIPS-Net	13.0	CB				
Total volume		30,8				35,2	

Explanatory note: CB= Central Bank, B= Commercial Bank and AS= Payment Association.
Source: Bank for International Settlements (Blue Book 2006), institutions' websites and annual reports.

A few major events set the current scene. The recent merger between the Dutch Interpay and the German Transaktionsinstitut resulted in Equens. Jointly they process 6.6 billion payments which makes Equens the second largest player in the ACH industry. STEP2 has leaped forward to the fourth largest player. The volume increase results from the Italian and Luxembourg domestic volumes. Both countries decided to quit their national systems and shift their domestic traffic to the pan-European STEP2 system. The other pivotal players in the ACH arena are: STET of France, UK’s Voca, SIBS of Portugal and the Spanish Iberpay. These payment processors have all become pan-European suppliers and most of them re-launched their platforms with advanced technologies. Evidently, there is a tendency towards a concentrated payment market structure.

3.3 Specific factors in the ACH industry

Governance structure

A remarkable trend is the rapid change of governance structure among the majority of ACHs between 2004 and 2007. Traditionally, processing payment transactions has been carried out by the banking industry. Most domestic ACHs were governed and operated by central banks and some have been owned by commercial banks. Financial statements of public payment processors are hardly available. It may be conjectured that public payment systems have been strongly subsidized by the national governments. Consequently, production factors might not have been allocated efficiently, causing market distortions.

Table 3.1 reveals that most ACHs switched their governance structure from public central bank owned to private entities. By becoming private (commercial bank owned) entities, ACHs position themselves to become competing players within the SEPA world. The same 'rules of the game' will apply as to private firms. In effect, this implies that the ACHs must publish their financial statements, thereby increasing transparency on operating costs and prices. Evidently, the governance structure of ACHs is a key element of the well-functioning ACH market.

The remaining, relatively small European payment processors will provide their domestic banks a solution during the transition towards the completion of SEPA. They will convert old national standards into new SEPA standards. After all, infrastructures and standards are not harmonised and implemented overnight. It is expected that the remaining payment processors, as SEPA matures, quit operations and transfer their total national volumes to other payment processors or engage in mergers.

Dual role of commercial banks

A complicating factor in the ACH industry is that most payment processors are now owned by the commercial banking community itself. This makes banks users and owners of ACHs at the same time; they are on the demand as well as on the supply side of the ACH market. The question that comes to mind is how this will influence effective competition. One might expect that domestic banks, because of this blurring relation between demand and supply, will stick to their own owned payment processors. This barrier can only be overcome if market conditions in the ACH industry are such that the ACHs will compete heavily on prices. This may then lead to a shift towards the most efficient processing providers. As a Dutch newspaper recently wrote 'Call for a tender puts high pressure on processing tariffs of debit cards'. In this case, ABN AMRO is a share holder of Interpay. The contract of ABN AMRO with Interpay had been expired. ABN AMRO has started to shop around in the pre-mature SEPA landscape for a new payment processor. Nevertheless, the bank again signed a contract with Interpay/Equens.[15] From this, one may question what the influence of ownership is in this market. In addition, it can be argued that if long-term contracts are signed, based on the ownership-demand relation, this inefficiency deters entry.[16] However, it remains an empirical issue how interrelated demand and supply conditions affect anti-competitive behaviour.

Network externalities

Following the IO literature on payment systems (Rochet and Tirole (1988), Bolt and Humphrey (2005), Schmiedel et al (2006)), the ACHs industry can be characterised by positive network externalities. In theory, positive network externalities arise when a good or service is more valuable to a user the more users adopt the same good or service. The ACH industry so exhibits distinct network externalities. The expected utility of using the services of an ACH for a bank positively depends on the number of other participating banks. Thus, if more banks are hooked up with the ACH, its coverage increases and less intermediate links are needed to reach other banks.

Size and scalability are important in payment systems due to their high capital-intensities. Electronic payment systems require considerable up-front investments in processing infrastructures, highly-secure telecommunication facilities and data storage, and apply complex operational standards and protocols. With high fixed costs, unit costs fall when payment volume increases, thereby providing a strong incentive to consolidate processing arrangements across borders to realize these volume-related benefits. Given this characteristic, an ACH will try to attract as much banks as possible, ultimately pushing smaller networks out of the market. Intuitively, network externalities are related to economies of scale. The more banks participating in a network, the larger the scale expansion and the more economies of scale can be exploited. Therefore, entry is likely to be limited. Successful entry seems to be possible only if the technology of a new platform will be such that it leads to substantial lower prices and banks can switch platforms.

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[15] Financieel Dagblad 26/01/2007.

[16] See also Tirole (1988), The Theory of Industrial Organisation, MIT Press.

Competition: Contestability and pricing

Following Baumol et al. (1988) the concept of contestability can be defined as a situation in which no actual competition exists. The potential treat of entry by itself, is effective in disciplining the incumbent firms, such that efficient prices and resource allocation will result. In the context of the ACH industry, a consultative paper of the European Commission states that policies regarding entry of non-bank payment service providers have not been included in the design of new SEPA schemes and frameworks.[17] The lack of the participation of non-bank payment institutions in the framework is of crucial importance to the extent of competition. If non-payment institutions will be allowed to enter the ACH industry, this may intensify competitive pressure on the existing players. This makes the market more contestable. Therefore, one can imagine a non-bank entering the market, which has developed a more efficient and sophisticated technology that enables the entrant to compete on lower prices. This will lead to a new equilibrium with reduced prices. However, non-bank players in the payment industry may require different regulatory attention.

3.4 Conclusion

This chapter analyses the basic characteristics and current trends in the European ACH industry. The above suggest that the ACH industry shows strong tendencies towards concentration, where commercial banks dominate the ACH industry in terms of ownership structure. In general, an imperfect market implies that there are one or more firms on the supply side of the market that are able to exert market power and influence prices. In addition, the market is populated by a large number of consumers. The services in this market are closely related but not identical.[18] It can be concluded that the ACH industry shows tendencies towards a oligopolistic market structure. The payment processing market is expected to realize substantial economies of scale. The extent of scale economies and the existence of network externalities may have a significant impact on the ACH market structure. In the next chapter, the extent of these scale economies will be tested empirically.

[17] European Commission, Consultative paper on SEPA incentives (2006).
[18] Nicholson, W. (1998), Microeconomic Theory Basic Principles and Extensions.

4. Scale economies in the ACH industry

As a result of intensifying European financial integration and the advent of SEPA in particular, the importance to study potential economies of scale from cross-border consolidation of payment processors is paramount. This chapter estimates payment scale economies for the European processing industry using a new dataset of ACH cost and sketches the potential cost benefits from consolidating electronic payment processing across borders.

In order to derive scale economies, the underlying production structure of ACHs is essential in understanding this multi-product competitive industry. A typical model to estimate the cost structure is the translog function. The translog cost function is widely used in empirical studies in the banking industry to analyse cost structures, see for instance Swank (1996). The same types of models that have been used in the banking industry are applied to the payment market, in particular the US payment market. In this study we also estimate a translog cost function to derive potential economies of scale in the European payment processing industry.

The remainder of this chapter is as follows. Section 4.1 discusses some related literature and in section 4.3 the translog cost model is described and its caveats explained. Section 4.4 describes the data in more detail and gives some first insights in the potential scale effects. The estimation results are presented and discussed in section 4.5, along with a thorough discussion of the induced payment scale economies. Section 4.6 concludes.

4.1 Some related literature

The consolidation process of US payment processing systems in the 90s led to a surge of interest in the existence of economies of scale in this industry. In contrast to the US, cross-border consolidation of European clearing houses has just started and research on the European payment market is in a premature state. Methods and results of US literature are therefore taken as a benchmark. Two important studies stand out. Bauer and Ferrier (1996) estimated single cost functions for check, ACH and Fedwire services by using data over the 1990-1994 period. They specified a translog cost function and found that significant economies of scale were to be gained among the existing ACHs. They concluded that the consolidation to one processing platform is justified. In contrast, economies of scale of processing checks and Fedwire services turned out to be fully exhausted. Check processing is labour-intensive and its productivity is not much affected by technological change.

Adams, Bauer and Sickles (2002) examined whether the Federal Reserve's payment processing services reveal economies of scale and scope. A multi-product translog model with three outputs, e.g. ACH services, Book-entry securities and Fedwire (interbank settlement transactions) services was estimated. They found little consistent evidence for economies of scope but did detect significant economies of scale.

Empirical studies on scale economies in the European payment industry are scarce but rapidly coming to the fore. Due to the persistent lack of data, research has been toilsome. Khiaonarong (2003) estimated a log linear cost function by using data of 21 payment systems and found substantial scale economies.[19] He emphasized the importance of ownership structure in payment systems and his results indicate the importance of institutional setting. [20] Bolt and Humphrey (2005) examined the potential for scale and scope economies of the large-value interbank payment system of the ECB, Target. Target is a public payment system that interconnects payment systems of 17 central banks in Europe. Due to lack of detailed cost data, the authors adopt estimation results of Khiaonarong (2003) and Federal Reserve studies. Based on these analyses, they argue that if Target succeeds in consolidating to a single platform, it would be able to realize strong economies of scale. In Bolt and Humphrey (2006), a data set including 11 European countries over 18 years is used to explain movements of operating costs in the banking sector as a function of transaction volumes of four separate payment instruments, and wages and capital costs. Their primary focus is on scale economies of card payments. The results show remarkable outcomes and their findings indicate that consolidation of payment processing across Europe could lead to significantly lower average cost per transaction. [21]

Some recent contributions to empirical research on economies of scale centered on European securities and settlement systems. The securities and settlement industry is closely related to the ACHs market in terms of processing. At present, two studies exist. A first comprehensive attempt to estimate economies of scale and scope in securities depository settlement industry has been done by Schmiedel et al. (2006). The authors assume each settlement institution to be a multi-product firm. The data set consists of 14 institutions in Europe, North America and

[19] Khiaonarong uses data of 10 European systems, of which 8 large-value systems and 2 ACHs, 9 East Asia-Pacific systems and 2 North America systems.
[20] To correct for ownership structures, a dummy is added to the regression.
[21] The realized scale economies yield an average estimate of .11 for debits cards, indicating a strong potential for cost reduction in debit card processing. Taken together, Bolt and Humphrey find (realized) scale economies of about .30.

Asia-Pacific. The sample period is 1993-2000. In order to evaluate economies of scale, both a single and a multi-output, translog cost function is estimated. The results show clear evidence of economies of scale. In the single product case, cost would increase by 69% if the number of securities settled is doubled. In the multiple output case, doubling of both outputs leads only to a 53% increase of total costs. Naturally, these findings support new alliances or mergers among settlement institutions. An alternative method to estimate economies of scale is examined by Van Cayseele and Wuyts (2006). The authors argue that central security depository systems (CSDs) are heterogeneous. They apply a fixed effects regression to correct for heterogeneity and the results suggest that economies of scale are present for all settlement institutions.

At the time of writing, there's no empirical research yet on the economies of scale in the European ACHs market. Following the Fourth Progress Report of the ECB (2006), the European harmonization of electronic payment systems requires the development of "... common instruments, standards, and infrastructures in order to foster substantial economies of scale". But do scale economies in the payment systems really exist? And if so, can we give some "reasonable" quantitative content to these potential scale economies? This chapter attempts to analyze potential economies of scale by a using a unique dataset of the European ACH market.

4.2 The model

4.2.1 Methodology

Knowledge of the underlying production and cost structure of payment processors is essential in order to derive potential economies of scale. The analysis of this chapter is based on the cost function. In essence, the cost function is a function of input prices and outputs, which is non-decreasing in outputs and linearly homogenous (of degree 1) in input prices. We assume that each ACH can be regarded as a firm that converts inputs into outputs, using a specific production technology, or production function. More specifically, an ACH is here assumed to employ a production process which involves the production of a single output (processed payment volume) from two inputs (labour and capital).

Mathematically, at the basis, it is assumed that there exists a twice-differentiable aggregate production function for the ACH industry. If input prices and output levels are exogenously determined, then the theory of duality between cost and production implies that the production function can be uniquely represented by a cost function. This cost function induces the cost minimizing level of producing the (single) output. As an example, given wages and rental prices, minimizing total costs subject to a Cobb-Douglas production function can be written as:

$$\text{Min } C = wL + rK \tag{1}$$
$$\text{s.t. } Y = f(L,K) = AL^{\alpha}K^{\beta}$$

The Langrangean of this constraint is written as:

$$L = rL + wK - \lambda\left(Y - AL^{\alpha}K^{\beta}\right) \tag{2}$$

After some algebraic manipulations, solving the first order conditions yields

$$C(y,w,r) = Ay^{(1/\alpha+\beta)}w^{(\alpha/\alpha+\beta)}r^{(\beta/\alpha+\beta)} \tag{3}$$

In our analysis, the (single) output of payment processors is captured by the number of processed payment transactions and, naturally, ACHs use labour and capital to produce their outputs. Following the recent literature (Schmiedel et al 2006, van Cayseele and Wuyts 2007, Bolt and Humphrey 2006) on payment systems, in order to evaluate scale economies in the ACH industry, we assume that the cost minimizing level of producing the single output can be represented by a translog cost function. We will estimate a Cobb-Douglas functional form as well, which can be regarded as a special case of the translog cost function. The translog function accounts for symmetry and non-linearities in output and input prices by including second order and interaction terms. The translog cost function is a flexible form that provides a second-order local Taylor approximation to any arbitrary cost function. [22] To ensure homogeneity in input prices and symmetry standard linear restrictions are imposed in our estimations.

In order to measure technological progress in the ACH industry we include a time trend in the estimations. The partial derivative of the cost function with respect to time will provide us with an indication of the rate of technological progress. The value should take a negative sign

[22] See Coelli et al (1998) for a thorough discussion of the translog functional form.

to indicate cost reductions as time passes by. That is, a shift along the cost curve as new technologies are adopted over time. In particular, in electronic payment systems, innovations in low-cost data storage and real-time processing and transmission have considerably lowered the unit costs of making payments over the last two decades.

Furthermore, to deal with heterogeneity among ACHs regarding differences in operating costs, in our model specification, we add a binary variable DPUBLIC that represents the ownership structure of payment processors. We conjecture that processors that are owned by national central banks are more heavily (cross-)subsidized, so that reported cost data only partially reflect true underlying payment processing costs. Khianonarong (2003) also argues that payment systems that are owned by central banks may face conflicts of interest, since competition and subsidization are inter-related factors. Van Cayseele and Wuyts (2007) argue as well that securities and settlement systems exhibit heterogeneity. They apply fixed and random effect estimation techniques to correct for different cost structures of each security and settlement system.

In order to derive scale economies, we estimate several cost functions from our sample data. We first estimate a simple loglinear model in order to gain some first insights in potential economies of scale in the ACH industry. Next, a loglinear Cobb-Douglas functional form is estimated. Then we turn to the single output translog cost model, discussing its estimation results as well as the induced economies of scale.

4.2.2 Model specification

The translog cost function (Christensen et al, 1973) with one single output is studied to derive economies of scale in the ACH industry. Since the translog cost function incorporates higher order and interaction terms, economies of scale may vary with the output level. The general functional form of the translog cost function is written as:

$$
\begin{aligned}
\ln OC = {} & \alpha_0 + \alpha_1 \ln Q + \frac{\alpha_{11}}{2}(\ln Q)^2 + \beta_1 \ln P_1 + \beta_2 \ln P_2 \\
& + \beta_{11}(\ln P_1)^2 + \beta_{22}(\ln P_2)^2 + \delta_{11} \ln Q \ln P_1 \\
& + \delta_{12} \ln Q \ln P_2 + \beta_{12} \ln P_1 \ln P_2 \\
& + \gamma_1 DPUBLIC + \gamma_2 TIME
\end{aligned}
\tag{4}
$$

where:

OC = total operating costs (in million euros)

Q = VOL (in number of processed payments) denotes the total payment volume

P_1 = $WAGE$ denotes the input price for labour

P_2 = $CAPC$ the input price for capital

$DPUBLIC$ = the binary variable for ownership structure

$TIME$ = time dummy for technological change

In the case that all second order and interaction terms are not different from zero, i.e. $\alpha_{11} = \beta_{11} = \beta_{12} = \beta_{22} = \delta_{11} = \delta_{12} = 0$, the above translog cost function reduces to a Cobb-Douglas cost function specification.

Economies of scale

In general, overall scale economies are determined by marginal cost over average cost, that is:

$$EoS = \frac{\partial \ln OC}{\partial \ln Q} = \frac{dOC}{dQ}\frac{Q}{OC} = \frac{MC}{AC} \tag{5}$$

Overall economies of scale exist if average cost falls as output increases. If we apply this to our translog cost function this translates into the following scale elasticity coefficient:

$$\varepsilon_1 = \frac{\partial \ln OC}{\partial \ln Q} = \alpha_1 + \alpha_{11} \ln Q + \delta_{11} \ln P_1 + \delta_{12} \ln P_2 \tag{6}$$

where ε_1 is called a scale elasticity with respect to output. Economies of scale are said to exist if a proportionate increase in all output levels raises cost less than proportionally. Economies of scale exist when ε_1 is smaller than one, $\varepsilon_1 < 1$. Constant returns to scale are obtained for $\varepsilon_1 = 1$, and diseconomies of scale exist for $\varepsilon_1 > 1$.

4.3 Data description

The data used for our analysis come from a variety of sources. First, payment volume data are obtained from ECBs "Blue Books" and BIS' "Red Books" for the years 1990-2005. These books do not only provide information about the total number of processed payment transactions, but also separately about payment volumes of credit transfers, direct debits, checks, and payment cards (debit and credit). Also, additional payment volume information was collected from the individual processors' Internet sites and their annual reports.

Second, cost data were retrieved from annual reports if possible, or directly through (bilateral) communications. Generally, cost data in payment systems are difficult to come by, and are not collected on any structural basis. In our analysis, we focus on total operating cost, composed of all labour, materials, outsourcing, capital consumption costs, but no interest expenses. Interest expenses are excluded, since they are functionally separable from the operating expense of providing payment services and their delivery to users.

Third, we used information about total labour cost in the banking sector, along with data on numbers of staff in the banking sector, to compute an annual wage rate as an input price.[23] These data were retrieved by using central bank statistics, national account statistics, and banking association's statistics across countries.[24] Further, we used the OECD Factbook (2006) to derive a measure of capital cost. As in Schmiedel et al (2006), we take expenditures on information and communication technology as a share of nominal fixed income as our capital cost input price.

Table 4.1 gives an overview of our sample of payment processors, together with some basic overall descriptive statistics. In total, the sample includes information of eight European payment processors with a total number of 67 observations.[25] The table clearly illustrates that the sample varies across the different ACHs in terms of processed volume, ownership structure and the range of observations over the years 1990-2005. However, in order to analyse potential cost savings from consolidation in the European ACH market, we pool the cross-section and time-series data.

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[23] See Koetter (2005) on measurement issues regarding input price proxies.

[24] See also Bolt and Humphrey (2006) on data issues regarding measurement of labour costs of banking sectors across countries.

[25] A few missing values in some series were estimated by simple inter- and extrapolations.

Table 4.1 Data, institutions and descriptive statistics

Processor	Country	Volume (mln, 2005)	Period	Obs	Ownership (dummy)
SIT	France	11982	1991-2005	15	0, NCB
Voca/BACS	U.K.	5134	2004-2005	2	1, banks
Interpay	Netherlands	3274	1990-2005	16	1, banks
TAI	Germany	3200	2003-2005	3	1, banks
SIBS	Portugal	1785	2002-2005	4	1, banks
CEC	Belgium	952	1990-1994	5	0, NCB
DIAS	Greece	29	1995-2005	11	0, NCB
LIPS-net	Luxemburg	14	1995-2005	11	0, NCB
Total		26368		67	4
Data	Variable	Mean	Median	Min	Max
Operating Cost	OC (euro, in mln)	68.08	23.64	1.76	384.89
Average Cost	AC (euro, trx)	0.13	0.10	0.002	0.46
Payment Volume	VOL WAGE (euro, in mln)	2176.17	1136.10	6.01	11982
Labour Cost	WAGE (euro, in mln)	0.08	0.07	0.04	0.21
Capital Cost	CAPC (percentage)	14.95	14.19	7.49	24.24
Ownership	DPUBLIC	=0 if owned by NCB, =1 else			
Technology	TIME	Time=1,…16 for year=1990,….,2005			

4.4 Empirical results

We start by estimating basic loglinear regressions using the total pooled sample. Models Ia-Ic in Table 4.2 provides us with a first understanding of possible scale effects. First in model Ia operating cost is regressed on the volume of payments only. In Model Ib and Ic operating cost is jointly regressed on volume, the binary variable DPUBLIC and Time.

Not surprisingly, we see in all three regressions a strong dependence on total payment volume. Also, the dummy is significant, indicating that central bank owned payment processors have lower average cost, which corroborates our conjecture. TIME represents technological progress and γ_2 should take a negative sign to indicate cost reductions as time passes by. The effect of technological change has the correct sign in model Ic, but is not significant.

Table 4.2 Loglinear regressions

Regressor	Coefficient	Estimation	Model Ib	Model Ic
CONSTANT	α_0	-0.01	0.39**	0.32
VOL	α_1	0.51***	0.31***	0.31***
DPUBLIC	γ_1		2.09***	2.09***
TIME	γ_2			0.01
EoS		0.50	0.30	0.31
Adj. R^2		0.62	0.87	0.87
Log Likelihood		-98.67	-58.85	-58.70
F-stat		98.11	231.64	152.79
N		67.00	67.00	67.00

Explanatory note: Dependent variable is log of real operating cost (OC/GDPP). Payment volume *VOL* is logged. Standard errors are corrected for heteroskedasticity and autocorrelation using Newey-West. Superscripts *, **, *** indicate significance of 10, 5, and 1 percent respectively.

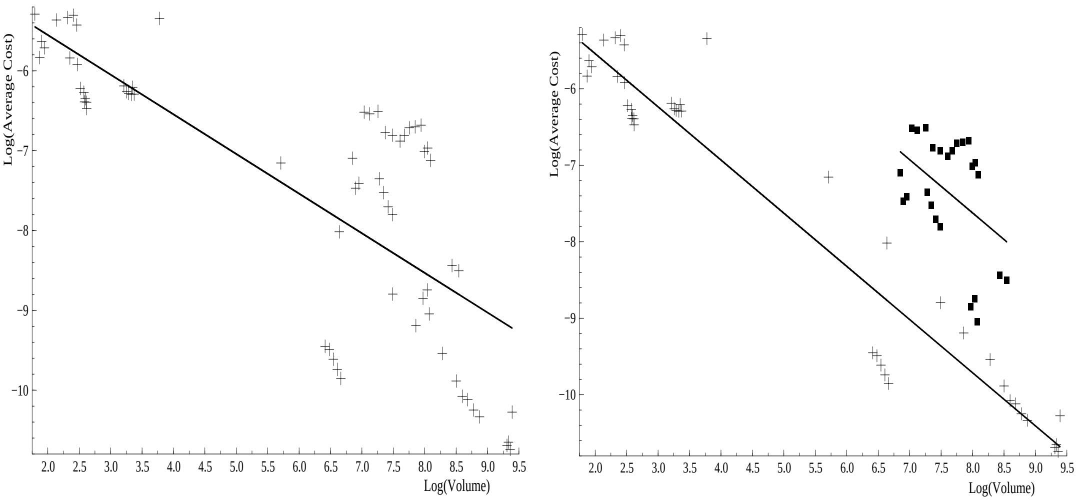
After a simple transformation, regression models Ia and Ib correspond to the fitted lines in the scatter diagrams of Figure 4.1. Figure 4.1, panel a) graphically presents the relation between volume and the associated cost. As is evident from the definition of economies of scale above, in loglinear models it simply holds that $EoS = \alpha_1$. Since there are no higher order or interaction terms present, the scale measure does not vary with total volume. That means that every payment processing site small or big realizes the same positive scale effects.

The negative slope of the straight line reveals a first crude measure of scale economies. More precisely, the slope is equal to -0.50 (with a t-statistic of -6.7), implying an economies of scale (EoS) measure of -0.50+1=0.50, with an adjusted R-squared of 0.59.[26] In figure 4.1 panel b), we have additionally corrected for ownership structure by incorporating the dummy DPUBLIC. Panel b) shows two lines, one line corresponding to payment processors owned and operated by a central bank, and the other (parallel) line for banks' owned processors. The regression results show that the adjusted R-squared jumps to 0.87 and the slope parameter now becomes -0.70 (with a t-statistic of 22.0), which implies economies of scale of 0.30. The estimated EoS measure roughly tells us that a doubling of the total processed volume only increases the total operating cost by about 30 percent. This would create strong incentives to consolidate operations among payment processors in Europe. However, these potential scale effects should obviously be adapted for possible influences of technological change and the development of input prices over time. Also, one should account for potential higher order

[26] This re-expression can be seen from AC=TC/Vol. Taking the logarithms lnAC=lnTC-lnVol, it is easy to see that equations lnAC= a + blnVol and lnTC= a + (b+1) lnVol are equivalent.

effects and interaction amongst the explanatory variables. This is exactly what the translog function approach explained in the next section does.

Figure 4.1: Economies of scale: simple loglinear relations



Note: Panel a) log of real unit costs versus log of total volume, not corrected for ownership structure; panel b) log of unit costs vs log of total volume, including ownership dummy.

4.4.1 A single output translog model

Since the simple loglinear regressions of the previous section are unable to capture non-linearities and the effects of input prices on operating cost, we extent our model by including higher-order and interaction terms. Tabel 4.3 shows the estimation results for several translog model specifications, where total payment volume (VOL) is used as the single output, along with two input prices ($WAGE$ and $CAPC$) to explain variations in total operating cost. The regressions are based on the translog cost function specified by Eq. (4).

The high R squared values show that all three models have high explanatory power. Model IIa is a simple log-linear regression with the restriction imposed that $\beta_1 + \beta_2 = 1$ in order to account for homogeneity in input prices of degree 1. In model IIb we include only quadratic terms to control for a possible non-linear relationship between the dependent and independent variables. Homogeneity in input prices requires in this case $\beta_1 + \beta_2 = 1$ and $\beta_{11} = -\beta 22$. Model IIc is the fully specified translog model extended by various interaction terms, where the homogeneity requirement now implies $\beta_1 + \beta_2 = 1$, $\beta_{11} = \beta_{22} = -\beta_{12}$ and $\delta_{11} = -\delta_{12}$. Compared to regressions of Model I of the previous section, the adjusted R-squared increases from about 87 to 95 percent. Again, the ownership dummy is significant. Note that in all translog regressions the time dummy has a significant impact now as well. The results show that technological change reduced costs at a five to eight percent yearly rate, which is a similar finding as in Schmiedel et al (2006).

Table 4.3 Translog regressions: single output

Regressor	Coefficient	Estimation Model IIa	Model IIb	Model IIc
CONSTANT	α_0	8.80***	10.52***	-24.95**
VOL	α_1	0.22***	-0.30	0.32
VOL^2	α_{11}		0.09***	0.06
WAGE	β_1	1.90***	2.03***	-11.17***
$WAGE^2$	β_{11}		0.16***	-2.45***
CAPC	β_2	-0.90***	-1.03***	12.17***
$CAPC^2$	β_{22}		-0.16***	-2.45***
VOL*WAGE	δ_{11}			0.08
VOL*CAPC	δ_{12}			-0.08
WAGE*CAPC	β_{12}			2.45***
DPUBLIC	τ_1	2.06***	2.35***	2.17***
TIME	τ_2	-0.06***	-0.05	-0.07***
EoS		0.22	0.25	0.22
Adj. R2		0.94	0.95	0.95
Log Likelihood		-33.69	-23.93	-24.35
F-stat		263.58	232.85	193.75
N		67	67	67

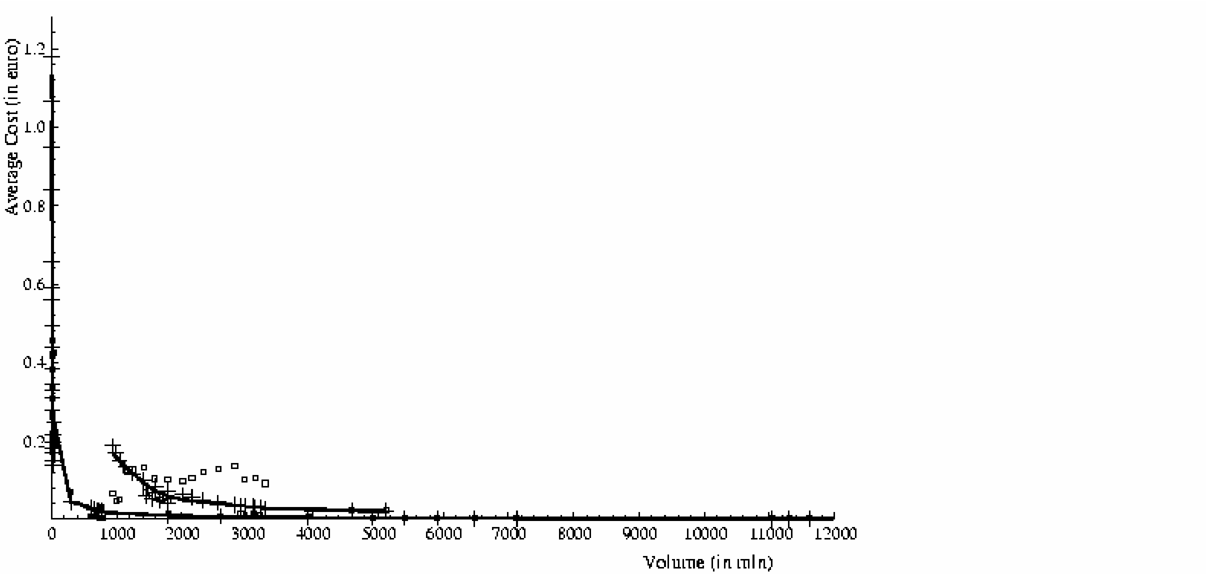
Explanatory note: Dependent variable is log of operating cost (OC). All regressors, except for dummies, are logged. EoS is averaged for models 2b and 2c. Standard errors are corrected for heteroskedasticity and autocorrelation using Newey-West. Superscripts *, **, *** indicate significance levels of 10, 5, and 1 percent respectively.

The estimations of the translog cost function allow us to derive parametric estimates of economies of scale. Scale elasticities are obtained by taking the first derivative of the translog cost function as specified by Eq. (6). The ACH specific scale elasticity is estimated at the sample mean. Table 4.3 also reports the (average) scale economies for the three translog regressions.

First, note that the derived (average) scale measure is fairly robust across our three regressions, indicating an average EoS measure between 0.22 and 0.25. Model IIa is the simplest model, strictly log-linear without any higher-order or interaction terms. This regression performs remarkably well in terms of parameter significance (all significant on 1 percent level). The derived economies of scale measure $EoS = 0.22$ indicates an even stronger potential for positive scale effects than the results of model I in the previous section. Since model IIa is fully log-linear, the EoS is constant across payment processors and does not depend on total payment volume.

Figure 4.2 shows the estimated average cost curves using the estimates of model IIc), and holding input prices constant at their mean level. The lower curve corresponds to payment processors that are owned by central banks, whereas the higher curve corresponds to banks' owned processors.

Figure 4.2: Prediction of average payment costs



Note: Open boxes indicate actual (real) average costs for banks' owned payment processors, solid boxes for central bank owned processors. The crosses are estimated values, and the curves are fitted trends (cubic splines).

To illustrate, the recent merger of two privately owned processors Dutch Interpay and German TAI will double their payment volume from 3 billion each to 6 billion total processed payments per year. Given our (average) measure $EoS = 0.22$, this implies that average costs could fall as much as 40 percent.[27] Our estimated (upper) curve in Figure 4.2 indicates a decrease from 4 eurocents to lower than 2 eurocents per transaction. Hence, the new payment processor called Equens will be much more cost efficient in the intra-European payment market.

---

[27] Given $AC_0 = OC_0 / VOL_0$, the merger would imply a new average cost of $AC_1 = OC_1 / VOL_1 = ((1+EoS)OC_0)/2V_0$. That is, $AC_1 = (1+EoS)/2\ AC_0 = 0.61\ AC_0$, implying a 40 percent decrease.

Table 4.4 Derived scale economies in translog model specification according to size and geographical location

Country	Model IIa	Model IIc
PT	0.22	0.29
GE	0.22	0.32
UK	0.22	0.35
FR	0.22	0.35
NL	0.22	0.32
GR	0.22	0.04
BE	0.22	0.22
LUX	0.22	-0.02
Average scale	0.22	0.22

Model IIc) is the fully specified model, with all higher-order and interaction terms included. It yields an average scale measure of 0.22. As an advantage, in this model the measure varies with payment volume, which allows us to separate individual payment processors in terms of scale effects, as shown in Table 4.4. Analysing scale economies by the size in terms of processed volume across European ACHs, we notice that, overall, substantial cost savings are to be gained in the payment processing market. The calculations show that the *EoS* varies between 0.04 (Dias-Greece) and 0.35 (SIT-France). Four out of eight payment processors (TAI-Germany (0.32), Interpay-Netherlands (0.32), Voca-UK (0.35), SIT-France (0.35)) have scale measures just above 0.30. CEC (Belgium) and SIBS (Portugal) show somewhat greater scale effects with measures of 0.22 and 0.29 respectively. The scale measure for the Luxembourg payment processors reveals a different picture. For LIPS-net (Luxembourg) a slight negative number was found (-0.02), which is plausible. It is well-known that the translog approach has problems estimating scale effects when volumes are very small, which seems to be the case here. LIPS-net processes less than 0.2 percent of total French payment volume. In any case, comparable to Dias (Greece), the translog estimation seems to point to a (positive) number close to zero, indicating large economies of scale. These figures indicate that the smaller processors have more scale potential than bigger ones, what seems to be likely. There seems to be no influence of ownership structure on the level of economies of scale.

A major drawback of the single output model is that it does not allow for different scale effects across different "produced" activities. Naturally, these types of activities require their own labour and capital intensities, implying different scale elasticities. The sum of these separate scale elasticities would yield the total economies of scale. The most obvious split-up of activities would be electronic payments versus paper-based payments. One would expect that the positive scale effects of electronic payment processing are much larger than paper-based processing. However, the quality of our data is insufficient to allow such a separation of activities. Further, with one output variable it makes little sense to analyse economies of scope. Moreover, the translog function is difficult to apply a study of investigating scope economies.[28] These issues promise further avenues for research.

4.5 Conclusion

This chapter examines the existence and extent of economies of scale in the European ACH industry. The importance of this exercise stems from the fact that the removal of cost inefficiencies is essential for the development of a common well-functioning payment market. The overall findings of this study confirm the existence of substantial economies of scale among European processing sites. Two important conclusions stand out. First, strong scale effects are possible when European payment processors would merge and consolidate their operations. Being cost-effective might prove to be the only viable business strategy in an emerging competitive, intra-European payment processing market when SEPA has arrived. Our calculations show that on average, a doubling of the payment volume would raise total operating cost by only approximately twenty to twenty-five percent. As an example, we estimated that the merger of Interpay and TAI could effectively lead to a 40 to 45 percent reduction in average costs. Given these large scale effects, a further tendency to merge may therefore be expected with the advent of SEPA.

Second, ownership structure of payment processors is significant to explain cost differences across payment processors. Overall, central bank owned processors show much lower average costs. Assuming no technological differences, it is likely that this finding is explained by differences between the degree of cross-subsidization and outsourcing of payment activities. Furthermore, the concept of economies of scale provides an indication of the competitive structure of the ACH industry. The existence of strong economies of scale suggests that the operating cost of ACHs may be distributed over a wider range of volume if the market consolidates. This may justify the market to consolidate to only a few ACHs in the near future.

[28] Adams, Bauer and Sickles (2002) found only little evidence for scope economies in Federal Reserve payment processing.

5. Concluding remarks

This thesis examined several aspects of the emerging pan-European payment processing industry. The pivotal role of efficient payment systems in creating a strong European economy has attracted the attention of research and policy makers. The successful completion of the Single Euro Payments Area project is of crucial importance for the existence of a truly Single Market. Recent developments in the European payment processing market are characterized by deeper integration, further consolidation and intensified competition. In this dynamic process, payment processors are revising their strategies in order to survive within SEPA.

Due to the natural tension between cooperation and competition and the very complex nature of the payment processing market, a spontaneous harmonization of the European payment industry by the banking sector did not occur. The European Commission was forced to implement directives and finally a regulation to put pressure on the banking industry to take action. In 2002 European banks committed themselves to make SEPA a reality by the end of 2010.

Over the past 15 years, we have observed a substantial increase in the usage of electronic payment instruments in Europe, suggesting a substitution process away from paper-based alternatives and cash. The increase in payment volumes has raised the potential of positive scale effects. Size and scalability are likely to be important for electronic payment processing due to high capital intensities. Naturally, with high fixed costs, unit processing cost should fall when volume increases. Furthermore, the payment market exhibits strong network externalities and it is shown that its governance structure is important for demand and supply. It is expected that SEPA will spur consolidations and mergers among European ACHs to fully realize the economies of scale.

We have shown that substantial economies of scale are to be gained in the European payment processing industry. In particular, we find that a doubling of payment volume may raise total cost with only 22 percent. Therefore, average cost should fall considerably, supporting further consolidation in the processing payment market in the near future. Our analysis also shows that governance structures are important to explain cost differentials between payment processors. It turns out that central bank owned payment processors show lower average costs. Assuming no differences in adopted payment technology, it is likely that this finding reflects differences in the degree of cross-subsidization. This result bears important implications for the competitive structure of the European processing industry.

Competition authorities and government institutions (EC, ECB, NCB) should act as a catalyst in promoting efficient and safe payment infrastructures, such that the existent economies of scale can be fully exploited. At the same time, adequate competition policy should be aimed at passing realized cost reductions onto end-users of payment instruments. Finally, SEPA may foster the entry of non-bank players in the European ACH industry. This will certainly have an effect on competitiveness, innovation and risk in payment markets. This opens up future avenues for research.

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Appendices

1. Present cross-border euro payments

This appendix describes the process set in motion by an economic agent who gives his bank an order to transfer money to another economic agent. The aim is to understand which parties and systems are involved in executing a payment transaction. First, I will provide a simplified description of the process of a domestic credit transfer. A credit transfer can be defined as an order from the originator to transfer an amount of money into the account of the beneficiary. Generally, banks and payment systems are used to execute the payment order. Some basic payment definitions used in the payment world will be explained in a domestic setting.
Next, a cross-border euro payment transaction will be described. This is a more complex process, since more parties and systems are involved and there are more possibilities to execute a payment transaction. I will lay out different elements of the payment system and show how they are linked to each other. This is followed by a description of an example of the execution of a cross-border euro payment. The example is described in a slightly more technical manner. This will give a good understanding of the complexity of executing payments transactions on a European level. The process is illustrated by graph 1.1, which will guide us through the route of a cross-border euro payment.

1.1 Identifying the parties in a payment cycle and their interaction

Domestic payments
When an economic agent wants to transfer money to another economic agent, it is interesting to note that actually many parties are involved in transferring the money into the account of the receiving party. The first question that comes to mind is why you need a bank. An alternative could be to put the amount of money in an envelope and just send it to the receiving party. The motivation of using a bank account lies in the simple fact that it is more safe and efficient. Banks are specialised in transferring amounts of money in an efficient and therefore a less time-consuming and less expensive manner.
In a payment transaction, often two banks are involved. An economic agent is holding its account at bank A and wants to transfer money to another economic agent who is holding an account at bank B. The banks involved have to exchange the information of the amount of

money and account numbers and wire the actual amount of the payment. If there are a large number of banks in a country and if a large volume of payment orders has to be executed, this becomes a complex process.

On a national level, this problem is often solved by using a third party, a central payment distribution system, also called an Automated Clearing House (ACH). The payment orders of a commercial bank are collected, bound together and offered to the ACH. The ACH checks the account numbers and identifies to which bank to transfer the payment order. An ACH basically processes and distributes the payment orders. This process is called clearing. Furthermore, the ACH sums up the amounts of the payment orders of banks on a bilateral base, which results in short and long positions of banks. The whole process of checking payment information, the distribution of payment orders and calculating the net balances is called the clearing of payment transactions. The banks have received the information of the payment orders from the ACH that need to be executed on behalf of their customers. Note that the actual money transfers between the banks, called interbank payments, have not been executed yet. Now, the ACH sends the information of the net positions resulting from processing payments, to the National Central Bank (NCB).

The role of the National Central Bank is as follows. All commercial banks hold an account at the National Central Bank (NCB).[29] The NCB provides a payment system to execute high-value interbank payments. The system of the NCB is a real-time gross settlement system. This means that once an interbank payment order is transmitted, it is immediately final. In this way the long participant is guaranteed to receive its interbank payments on behalf of its customers (i.e. corporates, customers etc). It is clear that if the customers of a bank do not receive their money, this may lead to economic distortions. Second, the NCB provides credit to the participating banks. If the balance of the bank account of a commercial bank held at the NCB is not sufficient, the credit provided by the NCB enables the interbank payments to be processed.

So, the NCB has received the net positions from the ACH. Next, the NCB debits and credits the accounts of the participating banks. This process is called settlement. After settlement has taken place, the positions of all commercial banks are zero. Next the commercial banks will transfer the amounts of money into the accounts of their customers. Hence, the payment cycle is closed. The conclusion is that to transfer money from A to B, in total five parties are involved.

[29] http://www.dnb.nl

Box 1.1 **SWIFT**

Another party involved in the payment processing cycle, is SWIFT. SWIFT is a computerized infrastructure that enables corporates, pension funds, banks and ACHs the secure exchange of payment order information among each other. SWIFT is used by all parties involved in the payment processing cycle for sending and receiving payment order information. Payment orders are identified on certain characteristics and are given standard codes that are used by all parties involved in the payment processing cycle. This enables the parties involved to speed up the process of executing a payment.

Source: http://www.swift.com

Cross-border payments

At the European level, the transfer of a payment transaction is more complex. The most important reason is that the national payment infrastructures and standards in Europe are highly fragmented. So far, national commercial banks have been reluctant to develop an integrated payment system to execute cross-border euro payment transactions. Imagine all commercial banks in Europe stick to their national payment systems and standards; it is a mess to execute a payment transaction on a European level. Another reason is that a larger number of banks are involved than in a domestic setting. Therefore, the total value of executed payment transactions is higher which increases systemic risk. Furthermore, as in domestic setting, a distinction is made between different originators of payment transactions. The distinction is made between payment orders from corporates, small and medium sized enterprises (SMEs), interbank payments and consumer payments. The reason for the distinction is that the value, the urgency and safety of each payment transaction differs. Therefore, different routes and payment systems are used.

In order to process cross-border euro payments more efficiently, the Euro Banking Association (EBA)[30] established three systems, two pure clearing systems (STEP1 and STEP2) and EURO1, which is both a clearing and a settlement system. Each system is used to process different types of payments. EURO1 and STEP1 both process high-value payments and STEP2 processes low-value payments (i.e. below EUR 50.000). The main reason for the

[30] http://www.abe.org

distinction between EURO1 and STEP1 is related to the protection of European financial stability and the type and value of payment orders.

EURO1 processes high-value payment orders that can originate from corporates, SMEs and interbank payment orders. The value of the exchanged payment orders by the participating banks does not exceed EUR 1 billion. Due to the high value of processed payment orders, the system is subject to so-called systemic risk. Systemic risk arises when a participating bank has not sufficient balance and fails to meet its obligation towards another participant. As in the domestic setting, this can lead to economic distortions.

To ensure financial stability, EURO1 processes each high-value payment order on an individual basis and imposes binding sending and receiving limits on the participating banks. During the day, EURO1 continuously checks the balances of the participants. If a payment order will lead to a breach of the sending or receiving capacity of a bank, the payment order is put on hold. As soon as the participant has sufficient balance, the payment order is processed. To ensure settlement to take place at the end of the day, the participants have set up a collateral pool of EUR 1 billion at the European Central Bank (ECB). Furthermore, EBA imposes strict admission criteria on banks that want to participate in the EURO1 system.[31]

If a bank is a member of the EURO1 system, it is automatically able to use STEP1 and STEP2. The admission criteria for the EURO1 system are much more stringent than for the STEP1 and STEP2 system. The STEP1 system has been established to enable more banks in Europe to route their payments through a central clearing house.[32] STEP1 processes commercial payments (i.e. corporates, SMEs and customer credit transfers). To make use of the STEP1 system, banks can either be a direct (a EURO1 participant) or indirect participant to the system. As an indirect participant, a bank is not subject to the strict admission criteria. Instead, an indirect participant must make an agreement with a EURO1 bank. The EURO1 bank provides the liquidity a STEP1 bank requires resulting from the calculated net positions. If the STEP1 bank has a negative net position, the EURO1 bank transfers the amount short to the system. The EURO1 bank basically acts as the "settlement bank" of the STEP1 participant. Different from the EURO1 system, STEP1 banks have a "zero debit cap". This means that the position of a STEP1 bank resulting from processing payment orders may not be negative. However, as in the EURO1 system, the participants in STEP1 are subject to

[31] For example, a member bank must have own funds of at least EUR 1.25 billion and a credit rating of at least P2 or A2. Source: www.abe.org

[32] http://www.abe.org

binding sending and receiving limits. The minimum limit is EUR 1 million up to a maximum of EUR 10 million. If a payment order exceeds the limits, they are rejected by the system.

STEP2 is the first pan-European Automated Clearing House (PE-ACH) for euro bulk payments. Bulk payments are a large series of payment orders bound together. During the day, bank A will save up all the consumer payment orders and send them, bound together in one file, to the STEP2 clearing system. STEP2 opens the files received from all banks and processes the orders and calculates the bilateral positions. The STEP2, STEP1 and EURO1 systems are interlinked, since settlement of the processed payment orders of STEP2, STEP1 and EURO1 take place at the EURO1 system. Now, why did EBA establish STEP2? Consider bank A receives 100 consumer cross-border payment orders. It is clear that it would be time-consuming and expensive for bank A to send all these orders to different banks within Europe. Therefore, bank A can choose to use the STEP2 system of EBA.

Now, as in the domestic setting, the resulting interbank obligations need to be transferred by the banks that are in a short position. Clearly, the amounts of these interbank payments can be very high. Therefore final settlement takes place through the TARGET settlement system of the European Central Bank (ECB).[33] The TARGET system interlinks all settlement systems of the NCBs. The interbank payments, also called payments in central bank money, are immediately final. This means that once the payment order is transmitted, it cannot be drawn back.

So, at the end of the day, EURO1 calculates the sum of the bilateral obligations to be settled between the banks. SWIFT sends each participant a message that contains their final balance resulting from all the payment orders processed. Banks that are in a short position send a payment instruction to their NCB in favour of the settlement account held at the ECB. The NCB credits the amount of the bank and transfers the obligated amount trough TARGET into their account at the ECB. In this way, the banks that are in a short position have covered their obligations. Now, the ECB credits the received interbank payments to the settlement account of EBA. EBA checks if all payments from the short participants are received and sends a message to the ECB to transfer the interbank payments into the accounts of the NCB of the banks that are in a long position. Next the ECB debits the EBA settlement account and credits the accounts of the NCBs of each long participant. Finally, the NCBs transfer the amounts of money into the accounts of their banks. In this way, the interbank payments are settled. No

[33] http://www.ecb.int/, European Automated Real Time Gross Settlement Express Transfer (TARGET)

bank owes another bank any amount of money**.** At last, the bank has received the actual amounts of money and distributes them into the accounts of the receiving customers.

1.2.1 Routing of the payment

This paragraph describes, in a more technical manner, how a payment order is processed. It shows how the clearing and settlement systems of EBA and the ECB are interlinked. Graph 1.1 illustrates the route of the payment order and will guide us through the processes. I assume a bulk payment to be executed. The reason is that STEP2, which processes bulk payments, has the first cut off time for transmitting payments. Furthermore, a bulk payment order needs to go through all the systems of EBA and ECB. In this way all systems are discussed.

A cross-border euro bulk payment

1) On day D-1, this is the day before settlement; a consumer sends a cross-border payment order through electronic banking to bank A. 2) Incoming payment orders at bank A will be identified on their characteristics. A high-value payment order either is sent to EURO1 or STEP1. In this case, the payment will be handled as a bulk-payment and bound together with other payment orders in a batch. 3) Bank A sends the batch to the STEP 2 system before 22.00 on day D-1. 4) Overnight STEP2 opens the batch and checks the IBAN and BIC[34] of the payment order. Together with all payment orders addressed to bank B, the payment messages are put into the “out-box” ready to be sent to bank B. First though, STEP2 sums up the amounts of all payment orders. Suppose the total amount of all payment orders to be transferred from bank A to bank B is EUR 100.000 and from bank B to bank A the total obligation is only EUR 50.000. Bank B has claim of EUR 50.000 on bank A.

5) At the start up of EURO1, at 07.30 through SWIFT, EURO1 receives the calculated single obligations from STEP2. EURO1 checks the balances of bank A and bank B. At the start up of EURO1 the balances of the participants are zero due to settlement on the previous day. It is clear that it is the best timing to successfully settle the single STEP2 obligations from STEP2.

6) EURO1 confirms that bank A and bank B to have sufficient balances to settle their obligations. 7) STEP2 receives the confirmation and puts the payment orders into the “out-box” of the participants. 8) At this point, bank B receives the information of our payment

[34] International Bank Account Number (IBAN) and Bank Identification Number (BIC)

order. Note that the amount of EUR 50.000 of bank B, who is in a long position, has not been transferred yet.

9) During the day, day D, more payment orders are sent to either STEP1 or directly to EURO1. The STEP1 system closes at 14.00 and EURO1 at 16.00. At 16.00 our payment order is summed up together with single payment orders from STEP1 and EURO1 in the EURO1 system. The end-of-day obligations are calculated, suppose bank A is in a total short position of EUR 1000.000 in favour of bank B.

10) Bank A and bank B are informed of their potential net balance by EURO1. 11) The obligated amount of money of bank A is transferred to the NCB in favour of the account of the NCB held at the ECB. 12) The NCB debits the account of bank A and transfers the interbank payment into the settlement account of EBA held at the ECB. 13) The ECB transfers the amount of money into the settlement account of EBA and informs EBA on the received amounts. 14) EBA releases a message to ECB that the single obligation is received. EBA gives the ECB instructions to debit the settlement account of EBA into the account of the NCB of bank B. 15) The ECB credits the account of the NCB of bank B. 16) The NCB of bank B credits the amount of the obligation into the account of bank B. In the last round, EBA Clearing informs all participants that the settlement procedure of interbank payments is completed. 17) The time and date our payment order is credited on the account at bank B depends on the policy of bank B. 18) The account of the receiver is credited. Hence, the payment cycle is closed.

Appendix 2 Cross-border euro payment cycle