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Finance from the Nova School of Business and Economics.

ASSESSMENT OF THE EFFICIENCY OF THE EUROPEAN PAYMENT SYSTEM

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Abstract

This research report performs an efficiency analysis of the European digital payment system. Its characterization was performed considering the evolution from cash to digital payments and the inherent risks, drivers of change, and trends. A novel payment system efficiency index is proposed and computed, where efficiency is defined as an optimization of cost, speed, availability, security, and convenience. Comparing with other regions, the EU is generally as efficient as the average benchmark, outperforming in terms of security but underperforming in terms of convenience. Improving instant payments and implementing the Digital Euro will be crucial to overcome the existing efficiency barriers.

Keywords: Payment System, Digital Payments, Efficiency of Payments, Europe

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Abbreviations

3DS – 3D Secure

AUD – Australian dollar

AUS – Australia’s ISO3 country code

BACS – Bankers’ Automated Clearing System

BIS – Bank for International Settlements

BOJ-NET – Bank of Japan Financial Network System

BRA – Brazil’s ISO3 country code

BRL – Brazilian real

CBDC – Central Bank Digital Currency

CHAPS – Clearing House Automated Payment System

CORE – Compensation Retail

CREST – Certificateless Registry for Electronic Share Transfer

CVM – Cardholder Verification Method

DNS – Deferred Net Settlement

EBA – European Banking Authority

ECB – European Central Bank

EEA – European Economic Area

EPC – European Payments Council

EU – European Union

FedWire – Federal Reserve Wire Network

GBP – British pound

GBR – United Kingdom’s ISO3 country code

IND – India’s ISO3 country code

INR – Indian rupee

JPN – Japan’s ISO3 country code

JPY – Japanese yen

LVPS – Large Value Payment System

MSC – Merchant Service Charge

N.A. – Not available

NEFT – National Electronic Funds Transfer

NFC – Near Field Communication

P2P – Peer-to-Peer

POS – Point-of-Sale

PSD – Payment Service Directive

PSP – Payment Services Provider

QR – Quick Response

RITS – Reserve Bank Information and Transfer System

RPS – Retail Payment System

RTGS – Real-Time Gross Settlement

SCA – Strong Customer Authentication

SCT Inst – SEPA Instant Credit Transfer

SEPA – Single Euro Payments Area

TARGET – Trans-European Automated Real-Time Gross Settlement Express Transfer

UK – United Kingdom

US – United States of America

USA – United States of America’s ISO3 country code

USD – US dollar

Introduction

This research report focuses on the assessment of the efficiency of the European digital payment system, answering the questions of 1) “What is and how can the European digital payment system be defined?” and 2) “To which extent and under which parameters is the European digital payment system efficient?”.

A payment system is understood as a set of “[...] instruments, banking procedures, and typically interbank funds transfer systems that ensure and facilitate the circulation of money” (Bank for International Settlements 2003). Payment systems are extremely important tools in today’s world, as they are integral parts of the financial sector, daily life, and, ultimately, the economy. Both retail and wholesale payments should be considered when assessing the system’s efficiency, as they best represent the system. On the one hand, the flows of goods and services are crucial for merchants’ and consumers’ activity (retail perspective), denoting the economy’s stimulation. On the other hand, the guarantee of efficient large-value transfers of funds among agents (wholesale perspective) is essential to provide the system’s reliability representation.

A descriptive and an analytical approach were carried out to address the two main research questions. Firstly, the descriptive approach was applied through the presentation of the general context, drivers of change, risks, and trends of the European payment system, found in chapters 1 to 4, respectively. In a second moment, the analytical approach was introduced in chapter 5 with the analysis of the efficiency of the European payment system, where a novel efficiency index is computed, allowing for an assessment and identification of barriers and possible improvements to the overall efficiency.

The European payment system, for which the EU is a proxy, is considered efficient if it presents an average or above average performance relative to the chosen benchmark: Australia, Brazil, India, Japan, UK, and US. This analysis was based on the efficiency index computed, in which

a combination of parameters, being them cost, speed, availability, security, and convenience, was chosen to illustrate the involved payment processes' quality and optimization.

Research Summary

The relevance of this research work relies on the value-added associated with 1) the unique aggregation of information which provides both an overview of how a payment system works and the factors affecting its evolution, which is hardly found in any single source, and 2) the innovative definition of an efficiency index, i.e. the englobed parameters and their characterization and ways of measurement.

On an overall assessment, the EU's digital payment system was concluded to be efficient. Furthermore, regarding speed, availability, and cost, one considered that the system has similar performance compared to the average benchmark. However, as a result of its leading position in the security parameter, the EU proved to be, on average, underperforming in terms of convenience.

The fragmentation resulting from the EU's agglomeration of countries, the interests' misalignment between the different players, and the impact of the foreign schemes present an additional challenge to the system's efficiency. As such, the European system undoubtedly presents room for improvement. In truth, the success achieved with its well-integrated wholesale system, TARGET2, can be extended to the retail system to unify Europe. Consequently, the increase in the adoption of instant payments, simultaneously with the creation of an own-issued digital currency (Digital Euro), are examples of potential upgrades that could take Europe to a higher efficiency level.

Chapter 1. General Context

1.1. Types of Payments and Historical Evolution

1.1.1. The Importance of Cash

Chapter 1.1.1. is about the importance of cash, addressing specifically the historical usage of cash in Europe, cash across Europe, the Eurosystem's cash strategy, the advantages of cash, and the disadvantages of cash. It belongs to the individual part of the student Manuel Palma Ferro (25926), and it can be consulted in his individual Work Project report, registered under the title "Assessment of the Efficiency of the European Payment System – Introducing Cash Relevance and Risks of the System" in the University thesis database RUN – University's Open Access Dissertations and Theses Repository.

1.1.2. The Emergence of Cashless Payments

Chapter 1.1.2. is about the emergence of cashless payments, addressing specifically the historical perspective of non-cash payment methods, the disruptive innovations in the payments' market, the current snapshot of non-cash payment methods, the advantages of non-cash payments, and the disadvantages of non-cash payments. It belongs to the individual part of the student Eduardo de Azevedo Teixeira (39401), and it can be consulted in his individual Work Project report, registered under the title "Assessment of the Efficiency of the European Payment System – Introducing Trends in Non-Cash Payments" in the University thesis database RUN – University's Open Access Dissertations and Theses Repository.

1.2. Payment System Processing

To understand a payment system, one must also consider all the processes in the backend of a transaction. According to BIS, a payment system is defined as a set of instruments, banking procedures, and usually interbank funds transfer systems that ensure money circulation. Moreover, a payment system is indispensable for the functioning of the economy, as it allows money to fulfill its role as means of exchange. If payment systems have been disregarded in the past, new events have revealed their importance as the core system for the stability of each nation.

Across regions, different digital payment methods entail distinct roles in the payment system. In the EU, card payments and credit transfers distance themselves from others. As previously mentioned, card payments are the most used payment method in the digital payment system volume-wise, while credit transfers have the highest share of transactions value-wise. To that end, to understand the processing of payments in Europe, it is firstly essential to study the different players, infrastructures, and components of the two most significant digital payment methods.

1.2.1. Card Payments

According to the ECB, a card is a device utilized by its holder to execute transactions or withdraw money. Cards can present one or more functions, being them cash, debit, delayed debit, credit, and e-money, though, as previously mentioned, they can only be classified into three types, which are debit, credit, and prepaid cards (European Central Bank 2022). As referred to in this chapter, card payments are the digital payment method in Europe with the highest volume of transactions. Besides, this payment method is the best representative of the retail side of the market. Hence, understanding how payments are processed mandatorily includes card payment transaction processing.

The Main Players and Models Involved

The Four-Party Model identifies the key participants in a card payment system:

- Cardholder – any customer, consumer, or corporation that owns a debit or credit card and uses it to purchase goods or services from a business;
- Merchant – any company with a business that sells goods and/or services to cardholders either in a physical location or online;
- Issuer (issuing bank) – financial institution that issues the debit or credit card to the cardholder;
- Acquirer – merchant bank that enrolls merchants to accept major card scheme payments and processes transactions on their behalf.

Although outside this model, card schemes are as crucial as the above-identified participants. Card schemes are card brands and networks that process card transactions by passing transaction details between the acquirer and the issuer. The two most relevant networks worldwide are Visa and Mastercard.

Moreover, there is another model in this industry, the Open Loop System Model, that is more extensive and considers three additional players. One of its players is the payment gateway, which encrypts the cardholder's data during a payment transaction, sending it from the merchant to the acquirer. It is only needed for online transactions and virtual terminals, and it acts as a gatekeeper for e-commerce transactions. The encryption of card data serves as a security measure, as it prevents access to and, consequently, decreases the likelihood of it being stolen. Another player is the payment processor, who provides processing services, executes transaction authorizations, and keeps account records, among other services. It serves as an intermediary in all retail transactions, both physical location and online ones. Contrary to payment gateways, payment processors use tokenization instead of encryption to protect cardholders' transaction data. Tokenization, like encryption, is a security measure, but it entails

substituting sensitive data. Finally, the last additional player is the technology provider, which guarantees the security of the transaction between the cardholder and the merchant.

Appendix 10 visually systematizes the Four-Party Model and the Open Loop System Model.

Acquirers, payment processors, and payment gateways form a broader type of payment industry participant, which is generally called Payment Service Providers (PSPs). If card schemes are added to the previous participants, then the collective denomination is only payment providers.

- Europe's Biggest Digital Payment Industry Players

Deloitte's *Key Players in the EU Payments Landscape* report identifies the biggest EU and non-EU companies (mainly American ones) operating in the EU in each type of industry player, based on 2020 data retrieved from Orbis. This data consists of the number of employees, the revenue, and the net profit of each company. It is important to remind that British digital payments industry players are now considered non-EU companies.

EU Companies

According to Deloitte, the top fourteen EU banks, this is the leading issuer and acquirer institutions, operating in the EU are Banco Santander, BNP Paribas, BBVA, Deutsche Bank, BPCE, Intesa SanPaolo, Société Générale, Crédit Agricole, ING, UniCredit, Rabobank, Commerzbank, Caixa Bank, and ABN Amro. Regarding PSPs, i.e. non-bank acquirers, processors, and gateways, the top nine are Adyen, Worldline, Edenred, Klarna, Bambora, Trustly, Payvision, Mollie, and Smart2Pay. The top five for local payment methods displays Klarna, Airplus, SIBS, European Merchant Services, and X Infotech. Lastly, concerning Banking as a Service, Arvato Financial is mentioned.

Non-EU Companies

Deloitte's top five non-EU banks operating in the EU is formed by Wells Fargo, JPMorgan Chase, Citibank, Barclays Bank, and HSBC Bank. When it comes to electronic money institutions, EML Payments Europe is highlighted. Global Payments, Verifone Systems, and Shift4Payments are the top three PSPs. In Banking as a Service, Fiserv and ACI Worldwide constitute the top two. The most interesting category is "others", as it consists of alternative payment methods, PayPal and Alipay, and an unconventional gateway in the remittances sector, which is Western Union.

Additionally, card schemes cannot be obliterated. It is the foremost case of Visa and Mastercard, both with significant market shares (58% and 41%, respectively), but of American Express and Diners Club too.

How Are Card Payments Processed?

After identifying the main participants and their roles, one can further subdivide card payments into physical location POS and online transactions. The processing of these two types of card payments is explained below.

- Physical Payment on a POS Terminal

A POS terminal is a hardware system that allows for processing card payments in merchants' physical locations. The participants in this type of transaction are the cardholder, the merchant, the issuer, the acquirer, the card scheme, and the payment processor (often the acquirer through the POS terminal).

In the first part of the transaction payment processing, the authorization, there is only an exchange of data between the acquirer and the issuer to understand whether the transaction can be authorized and take place afterwards. Figure 1 illustrates the authorization process.



Figure 1: Steps of a payment transaction process on a POS terminal - authorization

Source: Corporate Tools. Retrieved from <https://www.corporatetools.com/credit-card-processing/payment-process/>

The second part concerns clearing, entailing the amounts to be reconciled between the issuer and the acquirer, whereas the third and final part respects the settlement, where the actual transaction funds are transferred from the issuer to the acquirer and so to the merchant. Figure 2 illustrates the clearing and settlement processes.

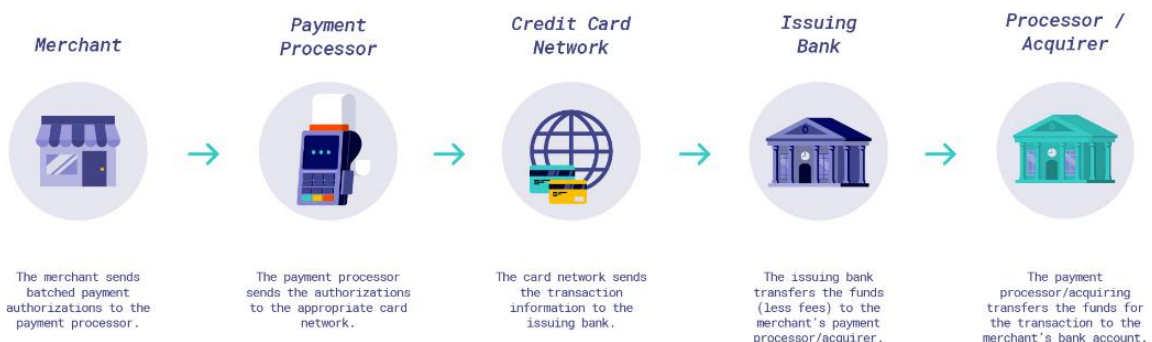


Figure 2: Steps of a payment transaction process on a POS terminal – clearing and settlement

Source: Corporate Tools. Retrieved from <https://www.corporatetools.com/credit-card-processing/payment-process/>

- Online Payment

The participants in this type of transaction are the cardholder, the merchant, the issuer, the acquirer, the card scheme, the payment gateway, and the payment processor. The payment gateway is new compared with card payments on a POS terminal. The payment gateway is an interface that connects the e-commerce platform and the payment processor. It collects cardholders' data from the retail website and conveys it to the payment processor. The payment processor operates as before, but not through a physical hardware format, such as the POS terminal. It is rather just online embedded.

This online payment process, represented in Figure 3, is similar to the one described above for POS terminal card payments. What differs is that now the process starts with the cardholder entering his debit or credit card details in the e-commerce's checkout and continues with the payment gateway encrypting those payment details and sending them to the payment processor.

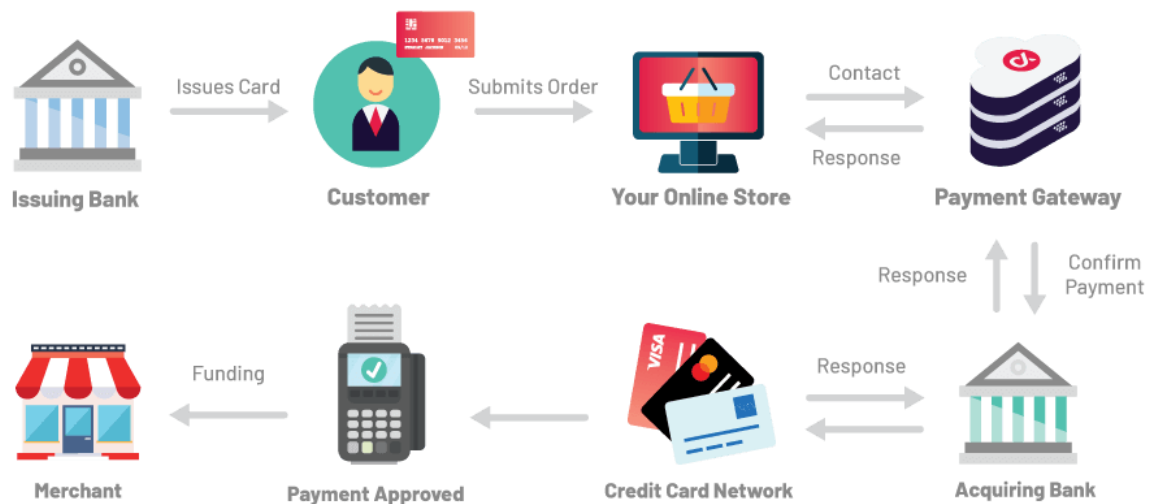


Figure 3: Steps of a payment transaction process on an e-commerce payment gateway

Source: Neha Sahay. Retrieved from <https://nehasahay.digital/how-a-top-model-makes-payment-gateways-work/>

Fees

A crucial aspect of a card payment is the fees the players involved in the transaction pay and receive. To render the necessary tools to accept cards, the merchant must pay the acquirer the

Merchant Service Charge (MSC). This implies that the merchant does not receive the total amount of the transaction, as the acquirer retains the MSC as a fee for the card acceptance service. The MSC is directly negotiated between the merchant and the acquirer, usually between 1% and 3% of the transaction value (Deloitte Financial Advisory Netherlands 2022). Typically, larger retailers have more bargaining power in negotiation than smaller ones. The MSC includes three components: the interchange fee, the scheme fee, and the acquirer markup.

The scheme fee is charged by the card scheme for its service in the card payment transaction processing. The acquirer markup is charged by the acquirer to the merchant, representing the previous' profit. The most significant component of the MSC is the interchange fee, and, as such, it serves as its minimum price floor. The interchange fee is set by the card scheme, but it is paid entirely to the issuer by the acquirer. It is seen as the payment required to cover the costs the issuer incurs in supplying card services. These costs are usually related to fraud prevention, system maintenance, and customer call centers, but they also allow for investment in payment technology innovation, such as contactless and mobile payments. [Appendix 11](#) illustrates the existing fees and who pays and collects them.

When deciding what fees to offer the issuers, card schemes face a conflict. On the one hand, they want to provide issuers high fees to be hired as the brand of the issued cards. On the other hand, if the interchange fee is set too high, the MSC would shoot up to a level in which the merchant would no longer be indifferent between being paid in cash or card, implying a reduction in digital transactions. These fees are reviewed periodically.

Interchange fees vary depending on the region, card type (consumer or commercial), card program (debit, credit, or pre-paid), and purchase environment (if the card is present or not during the transaction). In the EU, under the EU Regulation 2015/751, an interchange fee cap was imposed on card-present consumer rates: 0.2% for debit and prepaid card payments and 0.3% for credit card payments. For card-not-present and commercial transactions, card schemes

are free to establish the fee charged as the regulation does not apply. As an example, the discrimination of Visa and Mastercard's interchange fee rates is disclosed in [Appendix 12](#).

1.2.2. Credit Transfers

According to BIS, credit transfers are payment orders or a sequence of payment orders made to place funds at the beneficiary's disposal (Bank for International Settlements 2003). These transactions are an integral part of a digital payment system, as they are vital to the well-functioning of a country's economy, not only due to its retail component but mainly because of its wholesale one. Moreover, retail and wholesale transactions differ in size (with the former being small and the latter being large in value) and on the players involved (with non-banks usually incurring in retail and financial institutions in wholesale payments). Therefore, to fully understand how a payment is processed in a digital payment system, one should study the transfers that occur at these two levels: retail and wholesale.

Wholesale Credit Transfers

Wholesale credit transfers are commonly referred to as large-value transactions, which are "mainly exchanged between banks or between participants in the financial markets and usually require urgent and timely settlement" (Bank for International Settlements 2003). A malfunction of these transfers could have major consequences for global trade and finance. As their core failures occur due to infrastructure problems, central banks have an active role in managing the system (Carbó-Valverde e Kahn 2016). To that end, an analysis of wholesale payments naturally focuses on the decisions and goals of these financial institutions.

- How Are Wholesale Payments Processed?

In the 90s, large-value payments increased significantly, forcing central banks to adapt their wholesale processing infrastructures. Before this decade, wholesale systems relied on a Deferred Net Settlement (DNS) design. This system processes payments in batches and at a designated time of the day, exposing the system to different risks. By augmenting the time between the payment's initiation and receiving, the default risk between agents and the pressure payments awaiting settlement have on the system increase. To mitigate the exposure to these risks, central banks switched to Real-Time Gross Settlement (RTGS) systems. This design allows transactions to be processed individually and in real time, thus offering a mechanism for limiting risks in the payment system.

- Main Players Involved

The BIS recognizes that while central banks have been a crucial pillar of the payment system, the rise of large-value payments demanded them to have a more active role in the payment sector (Bank for International Settlements 2003). As RTGS systems require more central bank money to be supplied than traditional DNS infrastructures, they need to provide a wide range of mechanisms, such as intraday liquidity and liquidity-saving mechanisms, to ensure the smooth functioning of the system. Furthermore, wholesale systems act as middlemen between the different financial institutions, being commercial banks major players.

In addition to the different institutions involved, the RTGS infrastructures are core players of a large-value payment system. Out of the existing large-value real-time systems controlled by central banks, TARGET2 (in the EU) and FedWire (in the US) are the most important ones.

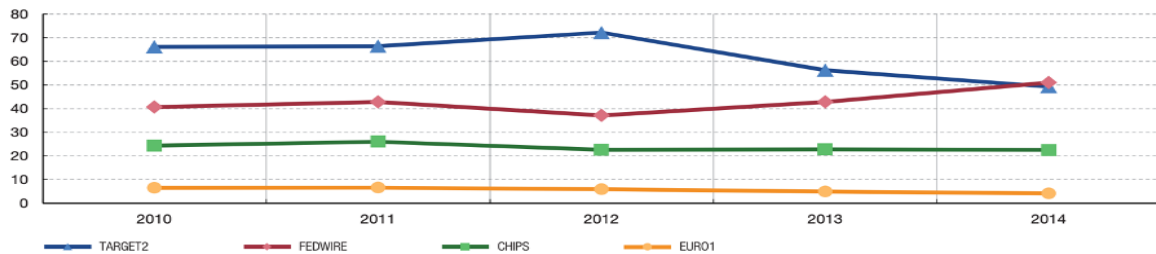


Figure 4: Large-value systems as a multiple of GDP in the US and the EU

Source: Bank for International Settlements. Retrieved from:

<https://repositorio.bde.es/bitstream/123456789/11303/1/restfin2016301.pdf>

Retail Credit Transfers

The retail component is also essential in a payment system. If wholesale payments occur mainly between financial institutions, retail transfers regard P2P (Peer-to-Peer), P2B (Peer-to-Business), and B2P (Business-to-Person) non-urgent and low-value transactions. However, not all systems have the same design within retail credit transfers. They can be divided into 1) traditional retail credit transfers and 2) instant payments, and depending on each region, one will have more importance than the other. This will be further analyzed in **Chapter 5**.

▪ How Are Retail Credit Transfers Processed in a DNS System?

Since the 20th century, retail credit transfers have been used to transfer money from one account to another, taking several days for the funds to reach the payee's account. Because retail credit transfers occur on a significantly higher volume than large-value transactions, traditionally, they have resorted to DNS systems. Moreover, DNS systems usually provide clearing services to reduce the number of interbank payments required. Clearing occurs multi-laterally, as the system computes each participant's net payable/receivable position on the transactions processed during the time considered (Cronin 2011). Hence, each system will have a predetermined number of daily settlement cycles, affecting the frequency of payments being processed. Ultimately, the DNS systems responsible for processing retail credit transfers will settle each net position through a large-value system, demonstrating the retail systems'

dependence on wholesale infrastructures. In the EU, even though the ECB supervises a pan-European DNS infrastructure (STEP2), most members resort to their national system to process domestic credit transfers, i.e. transactions which occur within participants of the same country. However, these national systems use a fully integrated pan-European wholesale infrastructure (TARGET2) to settle the large-value payments which result from the participants' net positions.

- How Are Retail Instant Payments Processed?

Unlike retail credit transfers processed through DNS systems, instant payments (or fast payments) offer participants the possibility of a credit transfer occurring in near real-time. While traditional credit transfers take several hours or days for the funds to reach the payee's account, fast payment systems can process transactions in seconds. Additionally, they could offer a rival pan-European payment method to card payments.

As will be studied in **Chapter 5**, there are already two successful cases of countries using this system for retail payments: Brazil and India. In Europe, even though there are some well-developed national instant payment infrastructures (e.g., MB WAY in Portugal), the pan-European infrastructure (SCT Inst) still lacks adoption – **Chapter 4**. Figure 5 demonstrates how instant payments are processed in SCT Inst:

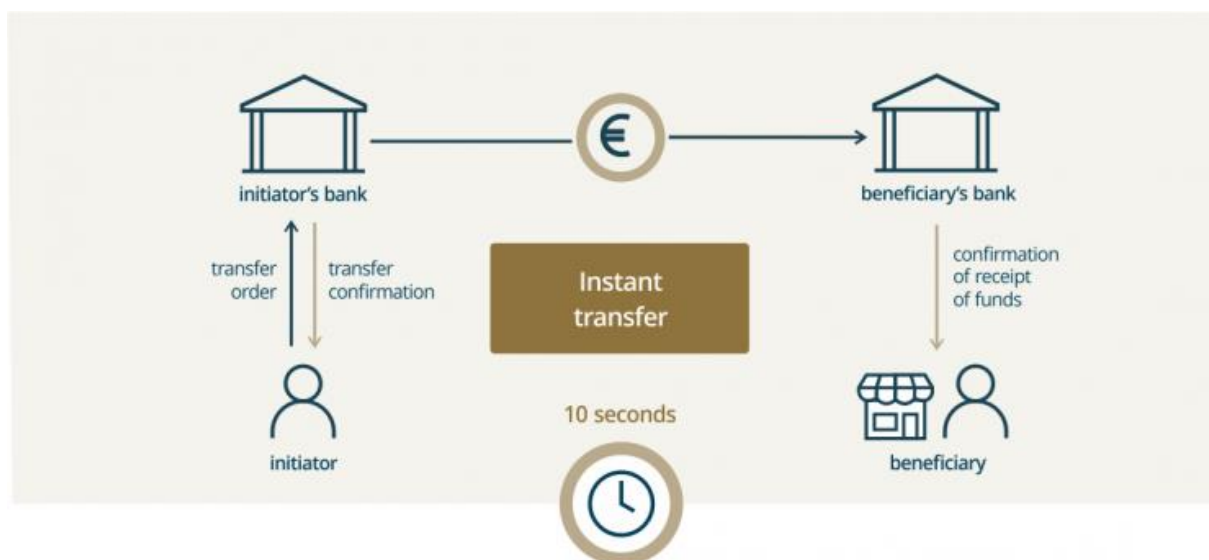


Figure 5: The operation of an instant payment in countries belonging to SEPA

Individual Part: Ana Mota

Source: Banco de Portugal. Retrieved from: <https://www.bportugal.pt/en/page/instant-tran>

1.3. What is Going on in Europe?

Chapter 1.3. is about what is going on in Europe in terms of the payment system, addressing specifically the common European payment schemes, each country and member state in Europe, and the weaponization of the world's payment system. It belongs to the individual part of the student Maria Joana Vassalo (38794), and it can be consulted in her individual Work Project report, registered under the title “Assessment of the Efficiency of the European Payment System – Introducing the Current European Snapshot” in the University thesis database RUN – University's Open Access Dissertations and Theses Repository.

Chapter 2. Drivers of Change

Chapter 2. is about the drivers of change of the European payment system, addressing specifically technology, European institutions through EU Directives and Regulations, and international standards. It belongs to the individual part of the student Maria Inês Melo (39058), and it can be consulted in her individual Work Project report, registered under the title “Assessment of the Efficiency of the European Payment System – Introducing the Drivers of Change” in the University thesis database RUN – University's Open Access Dissertations and Theses Repository.

Chapter 3. Risks

Chapter 3. is about the risks of a payment system, addressing specifically the liquidity risk, the credit risk, the settlement risk, the operational risk, the compliance risk, and the risk of illicit use. It belongs to the individual part of the student Manuel Palma Ferro (25926), and it can be consulted in his individual Work Project report, registered under the title “Assessment of the Efficiency of the European Payment System – Introducing Cash Relevance and Risks of the System” in the University thesis database RUN – University’s Open Access Dissertations and Theses Repository.

Chapter 4. Trends

Chapter 4. is about the trends in the European payment system, addressing specifically the impact of COVID-19, the rise of new cashless payment methods, the role of fintech on the rise of digital payments, and the European Union vision. It belongs to the individual part of the student Eduardo de Azevedo Teixeira (39401), and it can be consulted in his individual Work Project report, registered under the title “Assessment of the Efficiency of the European Payment System – Introducing Trends in Non-Cash Payments” in the University thesis database RUN – University’s Open Access Dissertations and Theses Repository.

Chapter 5. Efficiency

5.1. Efficiency Assessment

One of this report's main objectives is to assess the efficiency of the European digital payment system. As mentioned in **Chapter 1**, the purpose of this system is to fulfill the role of money as a means of exchange while expanding financial inclusion, fostering development, and supporting financial stability (The World Bank 2022). However, since a payment system is a complex concept, including different payment methods, infrastructure, and users, the assessment of its efficiency was not done in a traditional economic perspective. Instead, dimensions which are vital for the maximization of society's well-being were considered. In this sense, efficiency was defined as the optimal combination of five critical parameters of a payment system, considering users (consumers and merchants) and infrastructures perspectives, being them 1) cost, 2) speed, 3) availability, 4) security, and 5) convenience:

- Cost – was defined as the price each player pays to access the digital payment system. It is crucial to determine the efficiency of a payment system since it incorporates the financial impact the utilization of the different payment methods have on its users.
- Speed – was considered as the time required by the funds to reach the payee's account since the payment act. This variable is vital to a payment system, as it is not only a valuable dimension for users of retail payments (Kantar Public 2022), but also, a crucial pillar for the well-functioning of wholesale payments (**Chapter 1**). In this sense, speed contributes to better cash flow management, less liquidity and credit risk, greater economic integration between countries, and more effective monetary policies (Arner, et al. 2022).
- Availability – was defined in two scopes: 1) the likelihood of the payment system not breaking down, requiring repairs, or having operational incidents, and 2) the period during which it is possible for the payment system to be used. This parameter was focused on wholesale transactions, since there were insufficient data to assess each country's retail

system, and non-available large-value payment system can have catastrophic effects on a country's financial system (**Chapters 1 and 3**).

- Security – was defined as the quality of a payment being protected from dangers, threats, or losses. It is an important parameter to consider, as a payment system in which there is no confidence, even if excelling in other parameters, will jeopardize the well-functioning of the whole system. Contrary to availability, security was focused on retail transactions as these were the payments registering higher volume, and, as such, subject to higher security threats.
- Convenience – was designated as the quality of making payments more accessible and user-friendly for the payer by reducing the amount of effort or time required to execute it. Furthermore, a convenient payment system stimulates demand for payments, therefore facilitating transactions between customers and businesses. In this sense, as for other parameters it is considered a vital dimension by users in a payment system (Kantar Public 2022).

Note that the concept of economic efficiency consists of prices converging to the corresponding marginal cost of production. However, no data on the marginal cost of providing payment services and infrastructures are available. Additionally, even if data were available, this approach would have to account for the evaluation of the involved processes and their level of quality and optimization, dimensions that are vital to consumers and merchants.

To perform the relative analysis in question, the countries considered as the benchmark of the EU payment system were a combination of advanced and emerging economies: Australia, Japan, the UK, the US, Brazil, and India. These countries were chosen to provide a broad context of payment systems across continents. In North America, the most representative and developed digital payment system is the US one. In South America, Brazil was selected due to its recent successful experience with digital payments and its high growth potential. Regarding

Group Part

Asia, no data were available for China, and consequently, it was replaced by a system with enormous growth potential and one with strategic relevance: India and Japan, respectively. In Oceania, Australia was considered as the most representative country, being the one with the largest economy and the most developed payment system. Moreover, the UK was selected as it is a good comparable for the EU's system due to its geographic location and regulatory environment. Finally, no African countries were included because of insufficient data and the inexistence of comparable systems.

Furthermore, the method used to compare the different parameters between countries was a relative ranking classification with five levels, exhibited in Figure 8.

Level 1	Below Average
Level 2	Slightly Below Average
Level 3	Average
Level 4	Slightly Above Average
Level 5	Above Average

Figure 8: Relative ranking system – five levels and their meanings

The classification for the positioning depended on the analysis of each parameter being quantitative or qualitative. However, the principle behind the classification remained the same. Level 3 corresponds to the average performance level for the systems in each dimension. Regions could also be considered slightly below/above the average (levels 2 and 4, respectively) or significantly below/above (levels 1 and 5, respectively). On the one hand, for qualitative data, the conditions for the base system were determined, and the relative position of each system was then concluded. On the other hand, for quantitative data, the five levels were divided into quintiles between the best and worst-performing systems – regions were placed according to their positioning relative to the quintiles.

The two most representative digital payment methods in the EU's system were selected for the analysis: card payments and credit transfers. As evaluated in **Chapter 1**, card payments are the most popular non-cash payment method, with close to 51% number of non-cash transactions.

Group Part

Simultaneously, credit transfers are a vital pillar of the European system as, even though not being the most used payment method, they represented 94% of the EU's value for non-cash transactions in 2021.

Moreover, the analysis was not divided between retail and large-value transactions as data is usually reported in terms of payment methods. As such, the choice of card payments and credit transfers was the possible way of broadly characterizing the different payment sub-systems. Card payments being the payment method with the highest volume illustrates that this is a retail method, the one most used by the general public. Credit transfers are the method with the highest value exactly because they are essentially a large-value payment method. Cost, security, and convenience are crucial factors for the players involved in the retail sub-system, this being the reason behind including these as efficiency parameters. Speed, although being an important factor for users of retail payment systems, is also a vital pillar for financial stability of country's due to its importance in large-value transactions. On its turn, availability, was included in the efficiency index due to the impact large-value payment infrastructures' incidents can have on society's well-being.

Finally, for the two parameters of costs and convenience, currency conversion was needed for comparison purposes. Given the current market volatility which can introduce noise into the international comparisons, the average exchange rates of the last three years (December 7, 2019 – December 8, 2022), patent in Figure 9, were used.

Exchange Rates (Conversion to EUR)	
AUD	1.5830
BRL	5.8849
INR	84.7533
JPY	129.4900
GBP	0.8669
USD	1.1272

Figure 9: Average exchange rates (AUD, BRL, INR, JPY, GBP, and USD) for the period between December 7, 2019 and December 8, 2022

Source: European Central Bank. Retrieved from:

https://www.ecb.europa.eu/stats/policy_and_exchange_rates/euro_reference_exchange_rates/html/index.en.html

5.1.1. Cost

The first efficiency parameter to be evaluated is cost. Cost is the price each player pays to access the digital payment system. One decided to look at cost from the standpoint of both the consumer and the merchant, which are the users of PSPs' services. From the consumer's perspective, both card payments' and credit transfers' costs were analyzed. From the merchant's perspective, one assessed the fee the merchant must pay per payment to accept it. Therefore, this approach encompasses mainly the retail perspective. Nevertheless, by analyzing costs in this manner, it is likely that the wholesale cost is already englobed in the retail one, as the pricing schedule reflects the banks inherent costs to process the transactions.

Methodology and Limitations

The cost efficiency analysis of the digital payment system was based on the indicators presented in Figure 10.

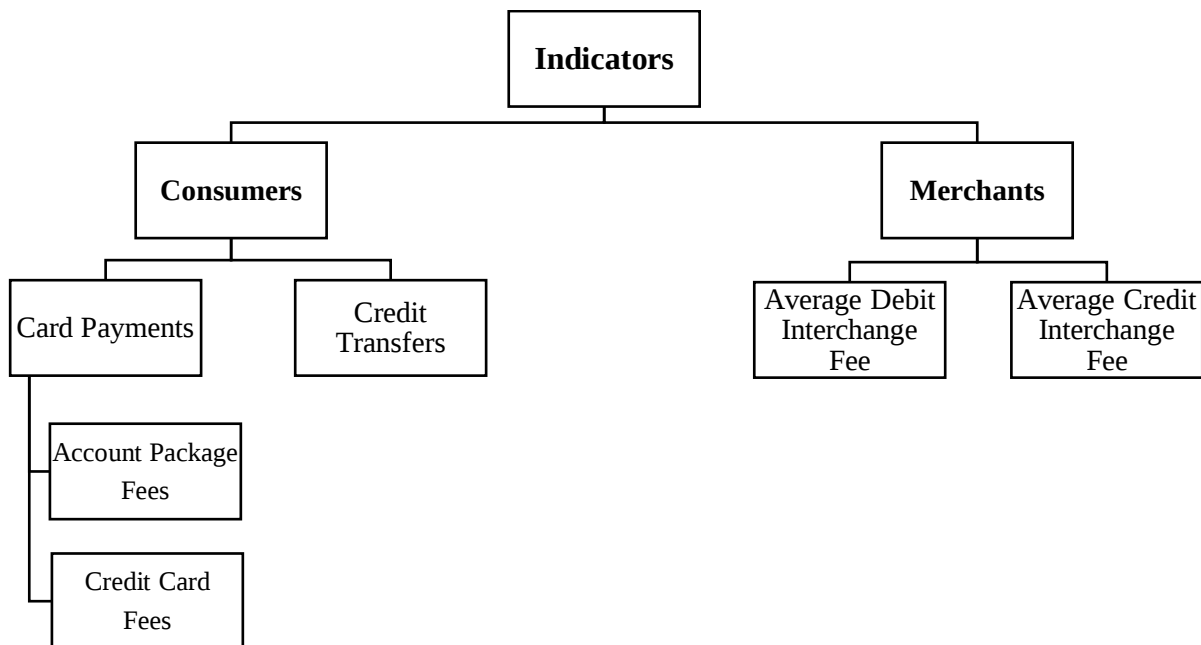


Figure 10: Indicators used for the cost efficiency comparison.

- Consumer

From a consumer's perspective, card payments' cost was measured through the annual fees associated with holding a debit or credit card. To better portray market preferences, one chose to study the card type most used in each region. According to FIS's *Global Payments Report*, debit card usage prevails in the EU, the UK, and Australia, whereas credit card usage prevails in the US and Brazil ([Appendix 23](#)). India was not considered because, in 2020, there were 0.65 debit cards and 0.04 credit cards per inhabitant (Bank for International Settlements 2020), meaning that the majority of the population still does not have access to card payments. As explained below, Japan was also not considered due to data limitations.

Debit cards are typically offered as part of a banking account package while credit cards are offered as a stand-alone payment card (EY 2020). Therefore, in the countries where debit cards are preferred, one decided to evaluate banks' account package annual fees, whereas for the countries where credit card usage prevails, one assessed banks' credit card annual fees. Given the diverse offer of card services and packages provided by banks, the analysis focused on the cheapest fee charged for an account package that includes the provision of a debit card. Caution is required when comparing the fee levels, as the difference may result from the distinct services included. The annual fee pertaining to credit cards is also the lowest available. A level related to card payments was given according to the average fee charged in each region.

Surcharging was not considered in the cost efficiency evaluation since it was impossible to determine the percentage of merchants that indeed surcharge payments in the regions that allow it, due to data unavailability. Thus, the possibility to surcharge does not constitute strong enough evidence to justify an adjustment to the level relating to card payments. As explained in **Chapter 2**, surcharging occurs when the merchant charges the client an additional fee for paying with a specific card to cover the cost incurred in accepting that payment.

Credit transfers were the other indicator considered important for the consumer, in which related costs were measured through banks' pricing schedules to make a regular online inter-bank domestic transfer. As a rule, the prices displayed are applied under the SHARE agreement, but other fees might apply under a different transfer fee arrangement. This agreement sees each party paying the charges levied by their PSP. Instant transfers were not considered an indicator since the charges in each region are never above €1. Nevertheless, the final level was adjusted to consider the performance of each region regarding instant transfers.

The data used in this analysis were retrieved from the public websites of the biggest commercial banks in each region, last accessed in November 2022. The Orbis platform was used to determine the largest banks in each region, according to their total assets as of 2021 ([Appendix 24](#)). Although the biggest Japanese banks were identified, it was not possible to retrieve the pertaining fees due to the lack of available data. As such, Japan was not included in this cross-region comparison. The summary of fees presented ([Appendix 25](#) and [Appendix 28](#)) is relative to where the bank is based, i.e., the presented fees for Santander are the fees the bank charges in Spain, the country where the bank is based.

The main limitations in the analysis from the consumer's perspective are:

- 1) the existence of cross-pricing – although some banks may charge lower or no fees for one service, they may compensate for this by charging higher fees for other services;
- 2) the different GDP levels and costs of living across regions – these differences may be reflected in the fees charged by financial institutions;
- 3) the exchange rate volatility – the cost comparison was only made possible because prices were all converted to the same currency, in this case, the euro.

- Merchant

It is also important to determine the cost the merchant pays to accept a debit and credit card payment. In retail payments, the merchant must pay the acquirer the Merchant Service Charge (MSC), besides the initial and maintenance fixed costs of having a bank account and the related hardware and software (POS terminal and online payment gateway) costs. The MSC represents the cost per transaction that the merchant must incur to accept card payments. Unfortunately, the average MSC was not available for all regions. As such, the conclusion was based on one of its components, the interchange fee, which is the one with the highest weight (Deloitte Financial Advisory Netherlands 2022). Therefore, a cross-region comparison was established based on the average debit and credit card interchange fees.

The main limitation of this analysis is that for some countries, the interchange fee cap was assumed to be the average interchange fee. Once again, it was not possible to obtain data for Japan. Even though the Japanese Fair Trade Commission mandated that interchange fees must be disclosed, these are not yet available. For the US, only the average debit card interchange fee was available.

Consumers

- Cards – EU and Abroad

To facilitate the cross-region comparison, it was computed an average of the fees charged by the banks in each region (for further detailed information within region please refer to [Appendix 25](#)). Figure 11 presents the data retrieved for each parameter and within each region. The level attributed to each region relative to card payments was based on the objective mathematical method of the five intervals (as detailed in [Appendix 26](#) and [Appendix 27](#)).

Group Part

	Average Account Package Annual Fee	Average Credit Card Annual Fee	Level
AUS	€ 22.74	-	3
BRA	-	€ 0.00	5
EU	€ 56.06	-	1
IND	-	-	-
JPN	N.A.	N.A.	N.A.
GBR	€ 0.00	-	5
USA	-	€ 0.00	5

Figure 11: Level attributed to card payments according to the average account package and credit card annual fees for Australia, Brazil, the EU, India, Japan, the UK, and the US

Source: CommBank of Australia, ANZ, Westpac, Banco Itaú, Banco Bradesco, Banco do Brasil, Santander, BNP Paribas, Société Générale, Deutsche Bank, Barclays, Lloyds, HSBC, JP Morgan Chase, Bank of America, Wells Fargo, Citi Bank and US Bank.

In the EU, annual account fees that include the provision of a debit card range between €0.0 and €96.0. Santander and Société Générale have the lowest annual account fees because they both provide their clients with branchless accounts. BBVA has the highest annual fee since the account includes both the provision of a debit and a credit card. The EU is the worst performing region being below average (level 1). UK banks offer zero annual account fees, which implies that it is one of the most efficient regions regarding card payments, being above average (level 5). In Australia, annual account fees that include the provision of a debit card range between €0.0 and €37.9. While ANZ also provides a free-of-charge branchless account, the other banks charge an annual fee. Although Australia has an average performance, fees can be waived under certain conditions.

American banks are the ones that provide their clients the most diverse credit card offering at no additional cost. In 2008, the Central Bank of Brazil approved a legislation which mandates that every national bank must offer a free of charge current account to its clients. This account must include amongst other things the provision of a debit and credit card. These are the main reasons for their above average performance (level 5).

Group Part

▪ Credit Transfers – EU and Abroad

The next step in the analysis is to understand how much consumers pay to make a domestic credit transfer, as displayed in Figure 12. Once again, to facilitate the cross-region comparison, it was computed an average of the fees charged by the banks in each region (for further detailed information within region please refer to [Appendix 28](#)). The levels attributed are in accordance with the objective mathematical method of the five intervals. ([Appendix 29](#) and [Appendix 30](#))

	Average Regular Transfer Fee	Level	Adjusted Level
AUS	N.A.	N.A.	N.A.
BRA	€ 1.95	5	5
EU	€ 27.95	1	1
IND	€ 0.00	5	5
JPN	N.A.	N.A.	N.A.
GBR	€ 2.79	5	5
USA	€ 24.84	1	3

Figure 12: Credit transfer level for Australia, Brazil, the EU, India, Japan, the UK, and the US

Source: Banco Itaú, Banco Bradesco, Banco do Brasil, Santander, BNP Paribas, Société Générale, Deutsche Bank, JP Morgan Chase, State Bank of India, HDFC, ICICI, Barclays, Lloyds, HSBC, Bank of America, Wells Fargo, Citi Bank and US Bank

Banks in Europe use two types of pricing schemes: a fixed charge and a percentual charge. In the second type, the final cost to the consumer is equal to the percentual charge levied times the transaction value the consumer wishes to transfer. To reach the average fee charged in this region, one had to compare the final costs of consumers regardless of the pricing scheme used by the bank. As such, for the banks that use the percentual charge pricing scheme, to determine the final cost, one multiplied the percentual charge levied by the average credit transfer transaction value, obtained by dividing the total value by the total volume of credit transfers (data retrieved from (European Central Bank 2022)).

Both the EU and the US have high fees for credit transfers, implying they have a below average performance (level 1). In contrast, the UK, Brazil and India have the highest level possible (level 5), with India's low prices resulting from the Reserve Bank of India's established limits on the charges banks can levy.

Group Part

The level obtained by evaluating the prices of regular credit transfers was adjusted to reflect the positioning of each region regarding instant transfers. SEPA instant transfers within the EU are the most expensive when compared with the other regions, implying that no upwards adjustment was made. American banks offer their clients access to Zelle, a payment app owned by the main financial institutions that allows quick person-to-person transactions at no cost. Based on this information, the US level was adjusted upwards (level 3) to reflect this positive impact. One of Brazil's main competitive advantages is Pix, an instant payment method created by the Brazilian Central Bank that is currently the second most used payment method ([Appendix 31](#)). Any person with a current or a savings account can perform a Pix transfer free of charge. UK banks also do not charge their clients for Faster Payments Service transfers, which is the instant transfer method available in the country. In India, instant transfers cost approximately zero, due to regulation in force. Since these regions already have the highest level (level 5), no adjustment was made.

Merchants

Figure 13 displays the average debit and the average credit interchange fees, which are a proxy for the costs merchants bear to accept card payments ([Appendix 32](#) to [Appendix 34](#)). The definition of the levels is detailed in [Appendix 35](#) and [Appendix 36](#).

	Debit Card Interchange Fee	Level	Credit Card Interchange Fee	Level
AUS	0.20%	4	0.80%	4
BRA	0.55%	1	1.65%	1
EU	0.20%	4	0.30%	5
IND	0.00%	5	N.A.	N.A.
JPN	N.A.	N.A.	N.A.	N.A.
GBR	0.20%	4	0.30%	5
USA	0.54%	1	N.A.	N.A.

Figure 13: Level attributed to Australia, Brazil, the EU, India, Japan, the UK, and the US, according to the average debit card interchange fee and credit card interchange fee

Source: Reserve Bank of Australia, Central Bank of Brazil, European Commission, Reserve Bank of India, and US Federal Reserve

Group Part

The differences in the presented fees result from the distinct rules of the regulations in force in each region. Some rules concern only consumer debit cards while others can be applicable to both consumer debit and credit cards ([Appendix 37](#)).

Moreover, the EU is the only region where the regulation in force stimulates pricing transparency by requiring all acquirers to offer merchants unblended fees. As such, merchants must have access to a detailed breakdown of the three fees that make up the MSC. In the unblended pricing scheme, the MSC varies according to the transaction type, whereas in a blended pricing, merchants are always charged the same fee ([Appendix 38](#)).

The US regulation is the only that includes a “no network exclusivity” clause which mandates that merchants can choose the network they want transactions to be processed through. Therefore, they can choose the one that implies the lowest cost, whereas in the EU the consumer has the possibility to override the merchant’s preference.

Is the EU’s Payment System Efficient, Cost-Wise?

The final level regarding cost efficiency was reached by performing an equally weighted average of the levels of the four indicators pertaining to the consumer and the merchant dimensions (Figure 14). The equally weighted average was chosen to reflect the equal importance of the perspectives of the consumer and the merchant. Within each perspective, it was also important to translate the equal significance of the indicators.

	<i>Consumer</i>		<i>Merchant</i>		Final Level
	Card Payments Level	Credit Transfers Level	Debit Card Interchange Fee Level	Credit Card Interchange Fee Level	
AUS	3	N.A.	4	4	4
BRA	5	5	1	1	3
EU	1	1	4	5	3
IND	N.A.	5	5	N.A.	5
JPN	N.A.	N.A.	N.A.	N.A.	N.A.
GBR	5	5	4	5	5
USA	5	3	1	N.A.	3

Figure 14: Final cost levels for Australia, Brazil, the EU, India, Japan, the UK, and the US

Group Part

Figure 15 depicts how the regions compare themselves regarding their cost efficiency level. The EU has an on average performance regarding cost efficiency (level 3). On the one hand, it has a strong performance from the perspective of the merchant due to the Interchange Fee Regulation. This regulation established a low cap level for both the debit and credit interchange fees, with the aim to reduce the cost of the merchant. On the other hand, it does not perform so well from the optic of the consumer since the fees charged are high when compared to the ones of the other regions.

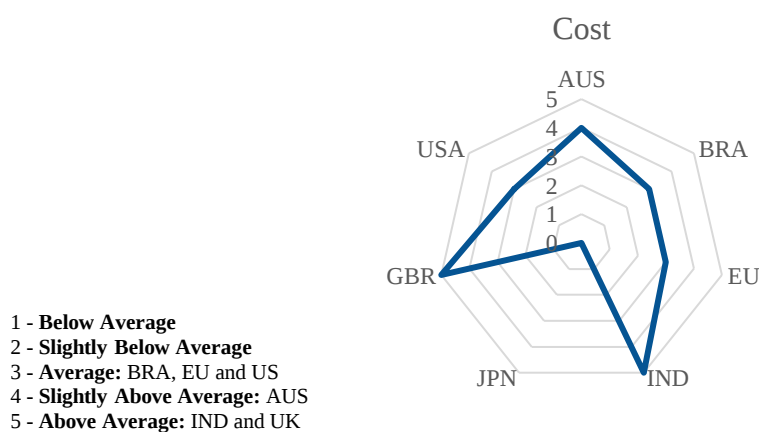


Figure 15: Radar graph on cost levels for Australia, Brazil, the EU, India, Japan, the UK, and the US

Both the UK and India are the most cost-efficient regions. The UK has a level of 5, because it performs above average from both the consumer and the merchant perspective due to: 1) zero fees regarding card payments and credit transfers and, 2) the Interchange Fee Regulation that caps the level of debit and credit cards interchange fees merchants must pay to accept a payment. India's final level is 5, yet this result is not as strong since it does not take into account card payments. Due to lack of available data, it was not possible to attribute a level to Japan.

5.1.2. Speed

To assess European efficiency, speed-wise, different systems were analyzed, establishing assumptions and limitations in the process. First and foremost, speed was defined as the time

required for the funds to reach the payee's account since the payment act. However, in retail payments, this analysis does not focus on the act of payment in-store or online, which takes seconds to be finalized. Instead, it regards the whole subsequent process, which requires, in some cases, several days to be completed. Moreover, this metric is important because it has crucial implications for the wholesale part of a payment system, which in turn can affect cash flow management, effective monetary policies, and economic integration between countries and regions (Arner, et al. 2022).

Methodology and Limitations

To have a broad characterization of the payment system, this analysis was based on a combination of different assessments for each payment system. As such, the parameter was split into 1) credit transfers, separated between large-value and retail transactions, and 2) card payments. For each case, a classification was established based on the regions' performance, using the five-level classification. However, the quintile method was only applied for the assessment of Retail Payment Systems (RPSs) since it was not appropriate for the evaluation of both LVPSs and card payments. In the end, the three systems' classifications were merged with equal weights, concluding the European system's positioning among its peers. The levels were merged with equal weights since they are equally important in understanding the impact speed has on a payment system. Overall, the main limitation of this analysis was the fact that the average transaction time was not disclosed for any of the systems. As such, a different approach was developed for each system, in which all regions were compared, resorting to several metrics described in Figure 16.

Credit Transfers	LVPS	1. RTGS schedule
	RPS	1. DNS number of settlement cycles 2. Penetration of instant payment system
Card Payments		1. Exposure to Visa and Mastercard processing technology

Figure 16: Indicators used to assess the efficiency of the European payment system speed-wise.

Credit Transfers' Analysis

As referred in **Chapter 1**, the main difference between LVPS and RPS is their infrastructure. Whereas LVPSs mostly use an RTGS design, i.e., settle individual transactions in near real-time, RPSs use DNS systems, which clear and settle payments in batches only a certain number of times per day. However, some countries are upgrading their RPSs to include a fast payment option (Figure 17).

Settlement Characteristics	Gross (individual)	Net (batches)
Designated-time (deferred)	Designated-time gross settlement	Designated-time net settlement (DNS)
Continuous (real-time)	Real-time gross settlement (RTGS)	(not applicable)

Figure 17: Characteristics of RTGS and DNS infrastructures

Source: Bank for International Settlement, 1997. Retrieved from: <https://www.bis.org/cpmi/publ/d22.pdf>

▪ Large-Value Payment Systems

The RTGS is a system well-suited for large-value payments due to the nature of these transactions. Large-value payments are time-critical and require the settlement to be individual and near real-time. Hence, firstly, a good metric to understand if a region has a strong LVPS, speed-wise, is to assess if it has an RTGS infrastructure. Furthermore, secondly, a crucial factor for RTGS infrastructures is liquidity. Lack of liquidity in the system means that, despite the technology being in place to perform a transaction in real-time, there are insufficient funds to complete the transfer (**Chapter 3**). Moreover, thirdly, when comparing RTGS systems, one factor affecting the speed at which a transaction is settled is the number of hours the system is open.

Considering the first two factors, there are no significant differences between countries, and so they were not included in the level of LVPSs. On the one hand, every country being assessed has an RTGS system and, therefore, can process large-value transactions in near real-time. On the other hand, the EU, the US, Australia, and Brazil have liquidity levels in their respective

Group Part

RTGS systems above 100%. For the other countries, data is not disclosed and cannot be evaluated. Notwithstanding, all RTGS systems have intraday liquidity systems to manage liquidity shortages. Accordingly, liquidity did not impose a severe limitation on the settlement of transactions for the different countries being assessed.

Regarding the third factor, all systems, apart from FedWire (US) and RTGS (India), have similar schedules. Whereas most countries are open between 11 to 12.5 hours, the FedWire and the RTGS are open for 21.5 and 24 hours, respectively ([Appendix 39](#)). Due to the significant difference between the schedules of these two systems and those of the other regions, the quintile method for assessing this metric was not used. Consequently, while the American and Indian RTGS systems were considered to have above-average performances (level 5), all others were classified as average (level 3), as seen in Figure 18.

<i>Assessment LVPS</i>	Hours Open	Level Associated
Australia (RITS)	11	3
Brazil (STR)	12	3
EU (TARGET2)	11	3
India (RTGS)	24	5
Japan (BOJ-NET)	12.5	3
UK (CHAPS)	12	3
US (FedWire)	21.5	5

*data not available

Figure 18: Assessment of LVPSs, speed-wise, according to the hours open

Source: Bank of International Settlements, Reserve Bank of Australia, Central Bank of Brazil, European Central Bank, Reserve Bank of India, Bank of Japan, Bank of England, and US Federal Reserve

Combining all factors, US and India's RTGS systems outperform their peers, being the differing factor the number of hours the system is open to process payments. However, when systems are open, evidence suggests they are able to process payments in near real-time. As such, every region, apart from the US and India, recorded an average performance relative to its peers. In the EU, according to the TARGET2 2021 Annual Report, 99.99% of all payments were settled within 5 minutes.

▪ Retail Payment Systems

Considering retail payment systems, the infrastructure most used in Europe is DNS since instant payments only account for 11% of SEPA credit transfers, and all other retail systems use a DNS design. Even so, the existence of a near real-time settlement system in retail payments is vital to improving the speed of a country's payment system. Hence, to determine the relative position of the RPS compared to its peers, both 1) the DNS systems and 2) the instant payment systems were assessed.

DNS System

The DNS system's popularity originates from the ability to process a large volume of transactions while not overheating the payment system. By clearing and settling payments in batches, liquidity and payment processing can be better managed. However, the trade-off is that transactions take hours, and sometimes days, to be completed, depending on the daily settlement cycles. Hence, assuming there are no other constraints, the more settlement cycles there are in a DNS throughout the day, the faster a system will process a payment order received. Consequently, the metric used to compare DNS systems across countries was the number of daily settlement cycles available, displayed in Figure 19.

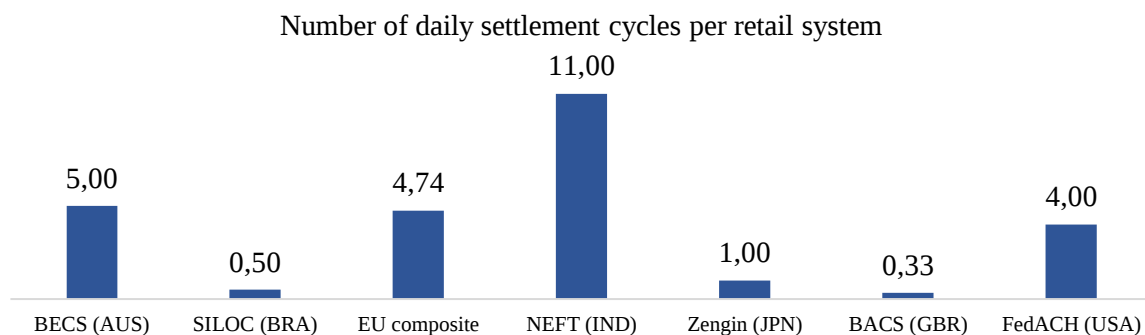


Figure 19: Number of daily settlement cycles per DNS system of each country

Source: Bank of International Settlements, Reserve Bank of Australia, European Central Bank, Bank of France, Zengin System, Bank of England, US Federal Reserve, Central Bank of Brazil, Reserve Bank of India, and Bank of Estonia

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For the European case, a composite index was calculated as a weighted average of the four most crucial RPSs: STEP2 (EU), CORE (France), RPS (Germany), and EquensWorldline (Netherlands). They have a combined share of 87% of the total number of retail transactions processed in the EU, excluding the systems which process exclusively direct debit transactions ([Appendix 40](#) and [Appendix 41](#)). Looking at the Figure 19, the fastest and most flexible retail system is NEFT, from India, with an average of 11 hourly cycles per day. This is in line with the Reserve Bank of India's goal to facilitate credit transfers, as India is a leader in the growth of credit transactions, recording a CAGR of 68% between 2017 and 2020 (Bank of India, 2022). Despite India's leadership, the EU's composite index suggests that Europe has flexible and fast payment infrastructures. Nevertheless, the systems included in the composite index differed significantly. For example, STEP2 has seven daily settlement cycles, whereas CORE only has one. Finally, the slowest system, out of all regions, is the UK's BACS, as it requires three days to clear and settle transactions.

Instant Payments

Considering instant payments, the EU has an infrastructure, SCT Inst, which can process retail transactions 24 hours a day, 7 days a week, 365 days a year, in a maximum of ten seconds. The adoption of this payment method is becoming more important in the payment systems, as the option to process in near real-time is more attractive than the ones presented by the traditional retail systems, which use DNS designs. Therefore, it was evaluated the share of instant payments as a percentage of the total number of credit transfers (Figure 20) because they provide a good indicator of the system's development and the availability of near real-time payments to the population. For the EU, the analysis only considered the common fast payment scheme in Europe and not the national ones, since firstly most countries do not have this infrastructure, and secondly, those that do, are only able to process domestic payments. As such,

even though there are some successful cases in instant payments, for example, MB WAY in Portugal, to assess the relative position of the EU against its peers, it was used the SCT Inst system.

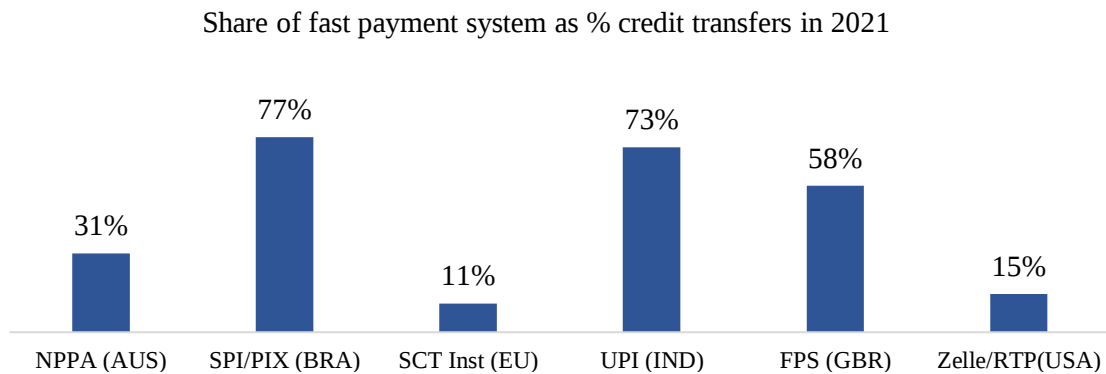


Figure 20: Share of instant payment systems as a percentage of credit transfers for Australia, Brazil, EU, India, the UK, and the US in 2021
 Source: Bank of International Settlements, New Payments Platform Australia, European Central Bank, Brazil Central Bank, Reserve Bank of India, and Bank of England

Japan, even though it has a system within the Zenging infrastructure, did not disclose the data on the volume of transactions using instant payments in 2021. Considering the rest of the regions, India and Brazil are leaders in instant payments. They have systems widely used by their population, increasing the average transaction speed of credit transfers considerably. In contrast, the EU instant payment system is still at an early stage. However, despite the growth since its launch, there are limitations preventing higher expansion, as mentioned in **Chapter 4**, thus registering an unsatisfactory performance. Likewise, the US is also at an early stage with only privately owned instant payment options, as the central bank will launch its fast payment infrastructure in 2023. To that end, since both regions have low penetration of instant payments as a percentage of credit transfers, they had significantly below-average performances (level 1).

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<i>Assessment RPS</i>	DNS System	Instant Payments	Level Associated
AUS	3	3	3
BRA	1	5	3
EU	3	1	2
IND	5	5	5
JPN	1	*	2
GBR	1	4	3
USA	2	1	2

* Insufficient data. However, Japan had an instant payment infrastructure.

Figure 21: Assessment of RPS speed-wise, according to the two selected dimensions

Overall, considering the speed of retail credit transfer systems, while India outperforms the other regions (level 5), the EU, the US, and Japan have slightly below-average performances (level 2). India is suited with a flexible system and a robust instant payment infrastructure that allows most credit transactions to be settled in near real-time. Following the example of India, the EU system has a good margin to grow, despite its average performance. Nonetheless, even if it had the most flexible DNS system, the speed of credit transfers is only optimized with instant payments. Hence, to outperform its benchmark, it will need to increase the penetration of its instant payment service to the population. More information on how these levels were calculated is disclosed in [Appendix 42](#), [Appendix 43](#), [Appendix 44](#), and [Appendix 45](#).

Card Payments' Analysis

The speed assessment regarding card payments was severely limited due to the high fragmentation of the card payment processing model, making it difficult to account for the time required in each step. Likewise, it was analyzed whether the EU payment system processed card payments swiftly compared to the benchmark countries. Furthermore, there are resemblances across card payment systems of different countries. All require card schemes to process transaction data, mainly Visa and Mastercard. As such, the metric used to conclude the speed of card payments was each country's exposure to Visa and Mastercard's card processing technology, i.e., the combined market share of these two companies in each assessed region.

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Visa and Mastercard have global authorization, clearing, and settlement systems. Therefore, countries with similar card scheme market shares will theoretically use the same global technology and, thus, process card payments with the same speed. On the authorization part, Visa and Mastercard process the information in seconds, as they have a global system able to provide an authorization response in near real-time. Once transactions are sent for clearing, the two companies use their respective global network systems. These are international deferred net clearing systems that process the batches of the different acquirers and issuers multiple times a day and compute the net position of each participant. In the end, the settlement usually occurs through settlement agents. In some cases, there may be bilateral agreements between acquirers and issuers, making it difficult to assess the duration of this step. All the steps on a global basis may take several days to be processed.

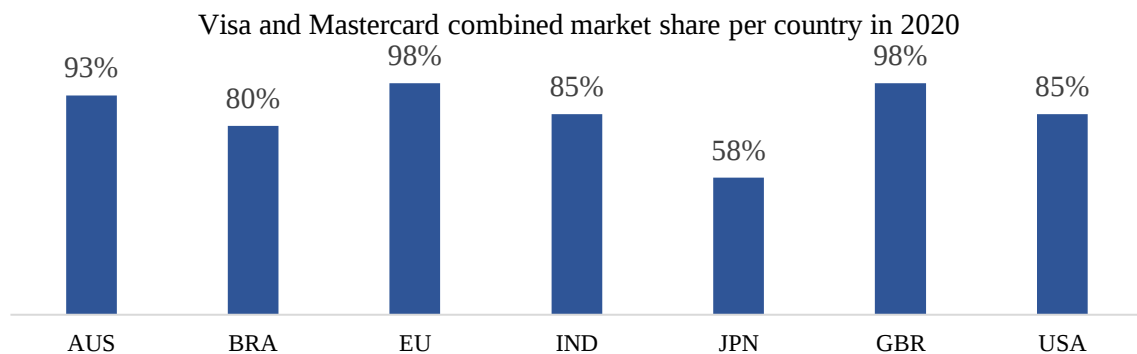


Figure 22: Visa and Mastercard combined market share for each country
Source: Statista, and Nilson Report

All in all, data demonstrates that all countries have extensive exposure to Visa and Mastercard (Figure 22). In that sense, countries have similar coverages by the two companies' technology used to process card payments. Thus, similar speeds across the authorization and clearing steps are expected. Hence, all countries have average performances (level 3). Nevertheless, data on the settlement agreements are not disclosed, due to their singularities. For that reason, contrasting with the concluded assessment, there may be significant differences between countries regarding the speed of card payments.

Is the EU's Payment System Efficient, Speed-Wise?

Combining the different systems, the EU is efficient, speed-wise, but it still has potential for improvement. Despite having several countries as members, it has a strong well-integrated LVPS system, which settles payments in near real-time. Also, its retail system has a flexible DNS system and an instant payment solution. Finally, even though the analysis was inconclusive, the EU, like the benchmark countries, has considerable exposure to Visa and Mastercard's processing technology. As a result, the EU is expected to have an average performance concerning the speed of card payments. Additionally, India is a leader in speed. It distinguishes itself from its peers as its RPS system combines a flexible DNS infrastructure with a well-developed, popular instant payment solution. Furthermore, despite its strong instant payment system, Brazil has a slow DNS infrastructure, downgrading its relative performance. Nevertheless, both cases are examples for the rest of the regions, including the EU, of implementing near real-time RPS systems to boost the speed of payments.

Country	Credit Transfers: LVPS	Credit Transfers: RPS	Card Payments	Final Level
AUS	3	3	3	3
BRA	3	3	3	3
EU	3	2	3	3
IND	5	5	3	4
JPN	3	2	3	3
GBR	3	3	3	3
USA	5	2	3	3

Figure 23: Final speed levels for Australia, Brazil, the EU, India, Japan, the UK, and the US

Group Part

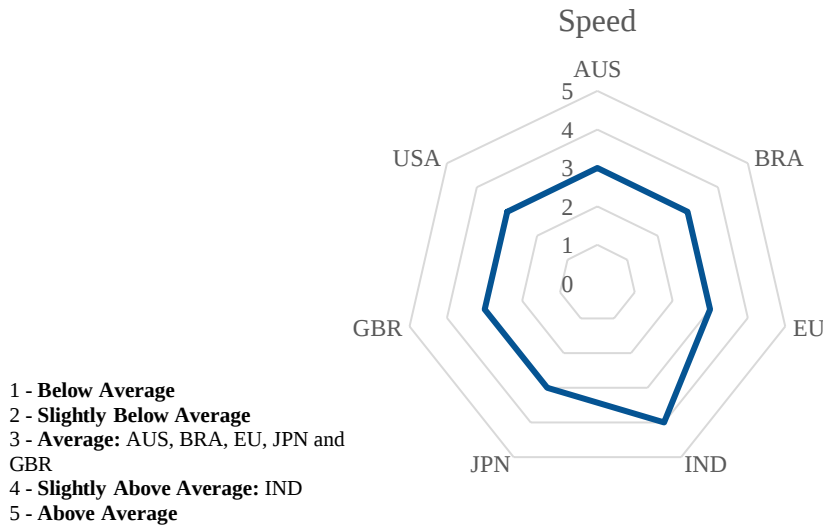


Figure 24: Radar graph on speed levels for Australia, Brazil, the EU, India, Japan, the UK, and the US

5.1.3. Availability

The third parameter considered for the efficiency measurement process was availability, which was defined in two dimensions: firstly, the likelihood of the payment system not breaking down, requiring repairs, or having operational incidents – a single event or a series of unforeseen related events that have or may have an adverse impact on the normal functioning of the payment system; and secondly, the period during which it will be possible for the payment system to be used. In this context, the availability of the payment system is of significant importance. Although, it was only possible to evaluate availability from a wholesale perspective, since there is no data available for the retail payment system. Having the fastest, cheapest, most secure, and most convenient payment system is not enough if it consistently fails or if it is only open for a few hours.

Methodology and Limitations

Countries' RTGS systems were used as an indicator to compare the availability for the following reasons:

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- 1) RTGS systems are LVPSs, a systemically important payment infrastructure, that is an integral part of a nation's payment system. These facilitate the real-time transfer of large amounts of money on a gross settlement basis, which reduces credit risk.
 - 2) Owned and operated by the central bank, they settle payments between banks and customers. These are also responsible for the final settlement files for ancillary payment systems to ensure settlement in central bank money.
 - 3) The data's availability, which allows for more uniform information within the chosen areas.
- For the EU, TARGET2, the leading European settlement and clearing platform for processing large-value payments in euros, was studied. It was possible to collect information on the number of incidents, delays, and availability measures, without requiring extra calculations. These data were available in TARGET2's annual reports.

For the UK, the payment system most similar to TARGET2 is CHAPS. In order to have the total availability of this payment system for each year, it was calculated the monthly average of five categories: 1) RTGS infrastructure for "urgent" CHAPS settlement, 2) RTGS infrastructure for "non-urgent" CHAPS settlement, 3) ability of RTGS and the RTGS-CREST link to support settlement in CREST, 4) delays to the net interbank settlement of retail payment systems (minutes), and 5) RTGS enquiry link. Each CHAPS payment is settled individually, in real-time, within the Bank of England's RTGS infrastructure. It was provided data for the availability of all the systems that settle in RTGS, i.e., not only for CHAPS payments but also for CREST, FPS (Faster Payments System), BACS, Visa Europe, and Mastercard.

In Japan, BOJ-NET is the payment system most comparable with those in the EU and the UK. However, the availability of this system is conditional on three additional payment infrastructures, owned and operated by commercial banks rather than the central bank, that are part of the Japanese payment system. The data available for this payment system was the number of operational incidents and the total transactions from 2017 to 2021. To assess

availability, the annual average of the percentage of incidents per the total number of transactions was computed.

The RITS, Australia's high-value settlement system, was used for the comparison. Banks and other authorized institutions adopt it to fulfil their payment commitments on an RTGS basis. As the Reserve Bank of Australia website provided the data regarding the availability of this payment system, no calculations were required.

Considering the US, there are two LVPSs: CHIPS (Clearing House Interbank Payments System) and FedWire Funds Service. Compared to TARGET2, the FedWire Funds Services is the most pertinent instrument since it is run and owned by the central bank. For mission-critical, same-day transactions, banks, companies, and government agencies rely on the FedWire Funds Service, which is marketed as the industry's leading electronic funds transfer service. However, since the US does not have the obligation by regulation to present extensive reports with the data necessary to make the comparison, it is impossible to find enough reliable data that allows for sustained comparisons. To that end, schedule was the only considered measure of availability.

For Brazil, the system studied was STR. In Brazil, Reserves Transfer System (STR) is an RTGS system for fund transfers. It is the backbone of the Brazilian financial system. The Central Bank of Brazil provided the data regarding the availability of this payment system for every month from 2017 to 2022, so the only calculation made was the annual average.

In India, the RTGS system was introduced in 2004 and has undergone several changes. With the RTGS system running 24/7 since December 14, 2020, India is one of the few countries worldwide with a 24/7 LVPS. Unfortunately, there is no numerical data regarding incidents in the system. However, in a report made by the Reserve Bank of India where the Indian payment system is compared with several others, India was considered "Moderate" in this indicator. Therefore, this will be the study used to describe India in terms of availability.

Availability Schedule

As RTGS systems process large-value transactions, their operating hours are significant to payment systems. By extending RTGS's operating hours, the pending transaction time will be lower, increasing the system's speed. In addition, further settlement cycles can be transferred to ancillary payment systems, reducing settlement, credit, and default risks, and improving the efficiency of the payments' ecosystem. A wide volume of operations between two particular jurisdictions' RTGS systems can be leveraged to integrate payment systems and enhance cross-border payment arrangements. When comparing other payment systems across the world, many dependent variables must be taken into consideration. However, as explained, all the systems compared concern RTGSs, owned and managed by the correspondent central bank in the regions with strategic relevance.

In Figure 25, it is possible to confirm that all the RTGS systems in question are operational during business days, even though the schedules have some slightly differences. Overall, all countries have a very similar schedule, except for India, which has a system open 24 hours a day, giving India leadership in this parameter.

Country	System	Closing time for same day transaction	Standard Opening hours closing			
			Opening	Closing	Daily Operational Period	Days
AUS	RITS	18:28 or 20:28	07:30	18:30 or 20:30	11 Hours	Business days
BRA	STR	18:30	06:30	18:30	12 Hours	Business days
EU	TARGET-2	18:00	07:00	18:00	11 Hours	Business days
IND	RTGS	-	00:30	-	24 Hours	Every day
JPN	BOJ-NET	21:00	08:30	21:00	12,5 Hours	Business days
GBR	Chaps Sterling	18:00	06:00	18:00	12 Hours	Business days
USA	Fedwire Funds Service	18:30	21:00 (D-1)	18:30	21,5 Hours	Business days

Figure 25: Standard Opening Hours and Standard Closing Hours

Source: Reserve Bank of Australia, European Central Bank, Bank of Japan, Bank of England, and US Federal Reserve

Success Rate

Comparing different countries in terms of incidents is tremendously challenging because each country has specific payment system particularities.

Considering the last five years and only the countries with available data, which are Australia, Brazil, Japan, UK, and US, the percentage of successful transactions is consistently above 99.8%, confirming the systems' resilience. Furthermore, even taking into account the oscillations in the number of errors, the systems prove to be highly efficient in terms of success in all assessed countries. Analyzing Figure 26, it is possible to verify that for the presented countries the level of availability in 2021 reached nearly 99.96%. During the same year, Visa reported a 99.99% success rate. The main conclusion is that, despite considering that the success rate is a significant indicator, it is not the determining one when assessing if a payment system is efficient, when compared with the benchmark ([Appendix 46](#) and [Appendix 47](#)).

<i>Regions</i>	2017	2018	2019	2020	2021	Average
AUS	99.99%	99.98%	99.83%	99.95%	99.96%	99.94%
BRA	99.92%	99.92%	99.88%	99.98%	99.92%	99.92%
EU	100.00%	99.98%	99.98%	99.46%	100.00%	99.88%
JPN	99.92%	99.89%	99.92%	99.92%	99.95%	99.92%
GBR	99.98%	99.99%	99.98%	99.96%	99.96%	99.97%

Figure 26: Annual success rate of each country

Source: Reserve Bank of Australia, Brazil Central Bank, European Central Bank, Bank of Japan, and Bank of England

Is the EU's Payment System Efficient, Availability-Wise?

The two countries with the highest daily operational hours are India (24 hours) and the US (21.5 hours), though there is no information regarding the success rate of these countries. For the remaining countries, the daily operational periods are very similar, ranging between 11 and 12 hours, so only the success rate was considered to study availability.

By taking an average of each region's success rates from 2017 until 2021, it can be observed that the UK and Australia have higher availability values. In contrast, the EU, Japan, and Brazil

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perform slightly worse. Since all the payment systems in the analysis have a success rate higher than 99% and are open at least 11 hours a day, it would be inappropriate to say that one is better than the other as all have outstanding performance results. Therefore, it was concluded that all payment systems were on average (level 3), with the exception of India which was considered below average (level 2) since it was attributed the level moderate (2 out of 4) in the Reserve Bank of India's *Benchmarking India's Payment System* - relative to the benchmarked countries. Figure 27 is a summary graph of this indicator.

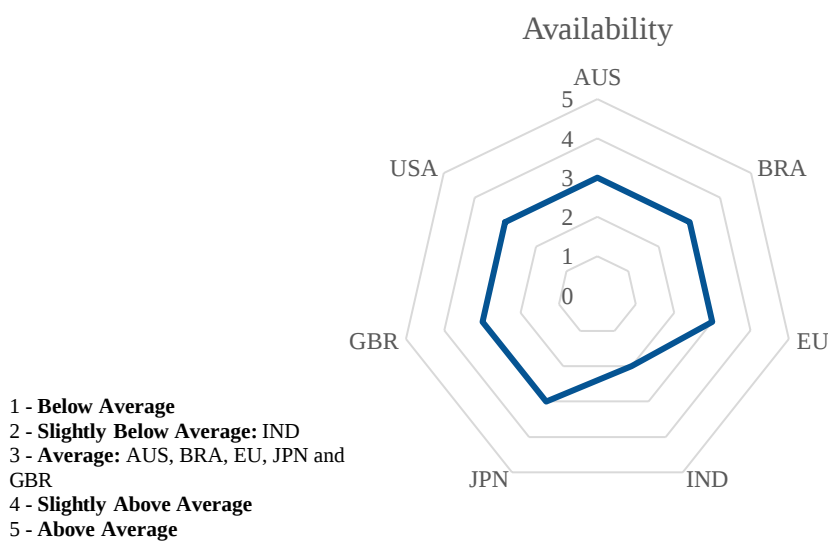


Figure 27: Radar graph on availability levels for Australia, Brazil, the EU, India, Japan, the UK, and the US

5.1.4. Security

One of the most important assets in a payment system is the confidence people have in it. Without confidence, as good as the system can be, it will not work because no one will participate in it. If the payer and the payee do not believe that the digital transaction operation will run safely, they will not be inclined to engage in it. Instead, they will prefer an in-person cash transaction, where they can reduce this transaction's risk almost to zero. For a wide acceptance of digital payments, the systems involved must provide and guarantee a secure network. Hence, security is a key factor in determining a payment system's efficiency. Objectively, security can be defined as the quality of a payment being protected from dangers,

threats, or losses. To measure it, payment fraud was chosen as it seems to be a very representative indicator, providing a broad assessment of a payment system's security, with objective data available.

The UK's Action Fraud (National Fraud & Cyber Crime Reporting Centre) states that "Payment fraud is any fraud that involves falsely creating or diverting payments. Payment fraud can include creating bogus customer records and bank accounts so that false payments can be generated; intercepting and altering payee details and amounts on cheques and Payable Orders, then attempting to cash them; creating false payment and financial information to support fraudulent claims for benefits; processing false claims by accomplices for benefits, grants or repayments; and self-authorizing payments to oneself."

For the analysis in question, one must split payment fraud in terms of payment instruments. As mentioned in this chapter, one would like to assess efficiency, in this case security-wise, from a card payment and a credit transfer perspective. Nonetheless, and according to the *Discussion Paper on the EBA's preliminary observations on selected payment fraud data under PSD2 as reported by the industry*, credit transfers are the payment instrument for which fraud rates are the lowest, both in terms of volume and value, and card payments reported by acquirers are the payment instrument for which the fraud rate is the highest, in the second semester of 2020. For that same period, the fraud rate of the total volume and the total value is, respectively, 29 and 42 times higher for card payments reported by acquirers than credit transfers. The EBA also states that card payments are the most frequently used payment instruments and that these transactions experience higher fraud rates. In this way, taking into consideration that credit transfer fraud rates are negligible and that there is a poor global report on these payment instruments' fraud, which does not allow for a reasonable and conclusive analysis, the subsequent discussion is going to address card payment fraud solely.

Card payment fraud encompasses the compromise of any personal information from debit, credit or store cards or the theft of the card itself, and the use of that information or the card to commit fraud, this is to purchase goods or services in the cardholder's name or to get unauthorized funds from the card's associated account.

Methodology and Limitations

It is challenging to infer the security of the EU's payment system due to two dimensions: 1) there is, in general, little information about payment systems' security and the way the existing data is reported defers in a system-by-system manner, and 2) the systems' countries or regions differ in card transactions volume and value, in currency, and in purchasing power.

When there is no concrete fraud data available, a subjective analysis is going to be presented based on consumer survey reports on global fraud from different years (Aité-2016 and Morning Consult-2022), where the purpose is to determine a country's security recurring to its ranking amongst other countries. Still, its reliability is limited.

When there is concrete fraud data available for 2019, some assumptions were established to solve the issues of card transactions' volume and value, and currency, while purchasing power differences were neglected. The differences in card transactions' volume and value were considered by comparing fraud as a share of the total value of card transactions. As in some cases reported volumes are less accurate than corresponding value figures, like it happens in the ECB's *Seventh report on card fraud*, it is more reliable to refer just to fraud as a share of the total value, instead of the volume, of card transactions. The issue of having values in distinct currencies was addressed by recurring to the 2019 average exchange rates.

The analysis in question aims at attributing the EU and the benchmark countries a number from 1 to 5, each corresponding to a level of security, allowing for an inference on the EU's security

ranking position. This position is then going to provide insights into whether the EU is efficient, security-wise.

Card Payment Fraud in the EU

The ECB's *Seventh report on card fraud* is the most recent, comprehensive, and detailed official data report on card payment fraud in the EU, even though it only focuses on 2019 data. Card payment schemes provide data that is broken down by SEPA country and cover almost the whole card market.

- Total Value of Fraudulent Card Transactions

The total value of transactions made using SEPA-issued cards in 2019 was €5.16 trillion. The total value of fraudulent transactions made using SEPA-issued and acquired worldwide cards was €1.87 billion, 0.036% of the total value of transactions. A percentage of 0.036% means that €3.6 cents per €100-worth of transactions were lost to fraud. While the value of card fraud rose by 3.4% from 2018 to 2019, the value of card transactions climbed by 6.5%. With transactions growing faster than fraud, fraud as a share of the total value of transactions went from 0.037% to 0.036% in this period. The 2015-2019 period's high was registered in 2015 (0.042%), whereas the low happened in 2017 (0.035%). (Appendix 48)

- Total Number of Fraudulent Card Transactions

From the 2019 total number of card transactions made using SEPA-issued cards (100.75 billion), 24.16 million were fraudulent. The 2019 volume of card fraud was higher in absolute (+14.8%) and relative (from 0.023% to 0.024%) terms concerning 2018, even though the total number of card transactions also expanded by 12.4%.

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▪ Average Value of Fraudulent Card Transactions

In 2019, the average value of a fraudulent transaction fell 10% compared with 2018 since the number of fraudulent card transactions has grown quicker than their value. The value of a fraudulent transaction in 2019 was about €77, 41% less than in 2015. ([Appendix 49](#))

Figure 28 summarizes the 2019 card payment fraud in the EU, specifically in the SEPA. The relevant indicator for the security comparison is fraud as a share of the total value of card transactions, which in this case was 0.036%.

2019	EU – SEPA
Total value of card transactions	€5.16 trillion
Total value of fraudulent card transactions	€1.87 billion
Fraud as a share of the total value of card transactions	0.036%
Total volume of card transactions	100.75 billion
Total volume of fraudulent card transactions	24.16 million
Fraud as a share of the total volume of card transactions	0.024%
Average value of fraudulent card transactions	€77

Figure 28: Summary table of the 2019 card payment fraud in the EU, specifically in the SEPA
Source: European Central Bank

Card Payment Fraud Abroad

For some countries in the analysis, there is concrete 2019 fraud data available, being the case of Australia, Japan, the UK, and the US. For each of them, fraud as a share of the total value of card transactions is going to be presented and compared with the others. Although Japan's data is only for credit card fraud, this is not a limitation because out of the 26.8% of cashless payments, credit card payments accounted for 24%, in 2019 (METI - Ministry of Economy, Trade and Industry 2022). For the remaining countries, this is India and Brazil, there is no concrete and reliable fraud data available, therefore leading to the use of consumer survey reports on global fraud.

- Australia, Japan, UK and US

Figure 29 summarizes the 2019 card payment fraud in Australia, Japan, the UK, and the US. Fraud as a share of the total value of card transactions was 0.057% in Australia, 0.042% in Japan, 0.075% in the UK, and 0.103% in the US. The value for Japan was not reported, but it was instead computed by dividing the total value of fraudulent card transactions by the total value of card transactions.

2019	AUS (€)	JPN (€)	GBR (€)	USA (€)
Average exchange rate (X/€)	1.6109	122.01	0.8778	1.1195
Total value of card transactions	€508.41 billion	€532.25 billion	€944.44 billion	-
Total value of fraudulent card transactions	€288.04 million	€224.65 million	€707.02 million	€8.59 billion
Fraud as a share of the total value of card transactions	0.057%	0.042%	0.075%	0.103%
Total volume of card transactions	11 billion	-	22 billion	-
Total volume of fraudulent card transactions	3.79 million	-	2.75 million	-
Fraud as a share of the total volume of card transactions	0.034%	-	-	-
Average value of fraudulent card transactions	€75.73	-	€257.47	-

Figure 29: 2019 card payment fraud comparison statistics for Australia, Japan, the UK, and the US
Source: Australian Payments Network, Statista, UK Finance, and Nilson Report

- India

According to the Aité's 2016 *Global Consumer Card Fraud: Where Card Fraud is Coming From*, the percentage of respondents who, in 2016, had experienced card fraud in the last five years in India was 37%, below Brazil's 49%, US's 47% and Australia's 40%, and above France's and UK's 29%, Germany's 18% and the Netherlands' 14%. Evaluating specifically fraud in the Asia-Pacific, consumers in India exhibited some of the highest-risk behaviors. This risky behavior and experiencing fraud clearly correlate. In the same region, consumers when asked whether they had confidence in their financial institution to protect them from card fraud, 6% of Indians said no, while in Australia that number was 9%.

- Brazil

Once again resorting to the Aité's *2016 Global Consumer Card Fraud: Where Card Fraud is Coming From*, the percentage of respondents who, in 2016, had experienced card fraud in the last five years in Brazil was 49%, above the US's 47%, Australia's 40%, India's 37%, France's and UK's 29%, Germany's 18% and the Netherlands' 14%. Evaluating specifically fraud in the Americas, consumers in Brazil were the ones that presented the riskiest behaviors, and when asked if they had confidence in their financial institution to protect them from card fraud, 14% said no (compared to 9% of Americans that said no).

The *2022 IBM Global Financial Fraud Impact Report* provides relevant key findings on card fraud in Brazil. It states that a third (31%) of Brazilian consumers have experienced credit card fraud, the country in the analysis with the highest percentage, above US's 18%, Japan's 9%, and Germany's 7%. Regarding debit card fraud, Brazil's percentage fell significantly to 6%, above Germany's and Japan's 1%, but clearly below the US's 19%. Brazilian adults were one of the most concerned with financial security issues. When asked how concerned consumers were that the following types of financial security issues may happen to them in the future, 85% of Brazilians were concerned with credit card fraud and 81% with debit card fraud, in both cases more than Germans (48% and 40%), Americans (59% and 62%) and Japanese (72% and 47%). Concerning how much money consumers have lost from fraudulent charges in the last 12 months, Brazil presented an average price of BRL 2,978.23 (USD 581.35), higher than Japan's JPY 12,852.5 (USD 11.19) and the US's USD 265.09, though much lower than the leader Germany's €3,519.99 (USD 3,917.4).

Is the EU's Payment System Efficient, Security-Wise?

The lowest the fraud rate, the highest the level of security. As mentioned, fraud as a share of the total value of card transactions in 2019 was 0.057% in Australia, 0.036% in the EU, 0.042%

Group Part

in Japan, 0.075% in the UK, and 0.103% in the US. This implies that the EU had the lowest fraud rate, Japan the second, Australia the third, the UK the fourth and the US the highest. In this way, the EU was the most secure region in this group, being the most efficient, security-wise. (Figure 30)

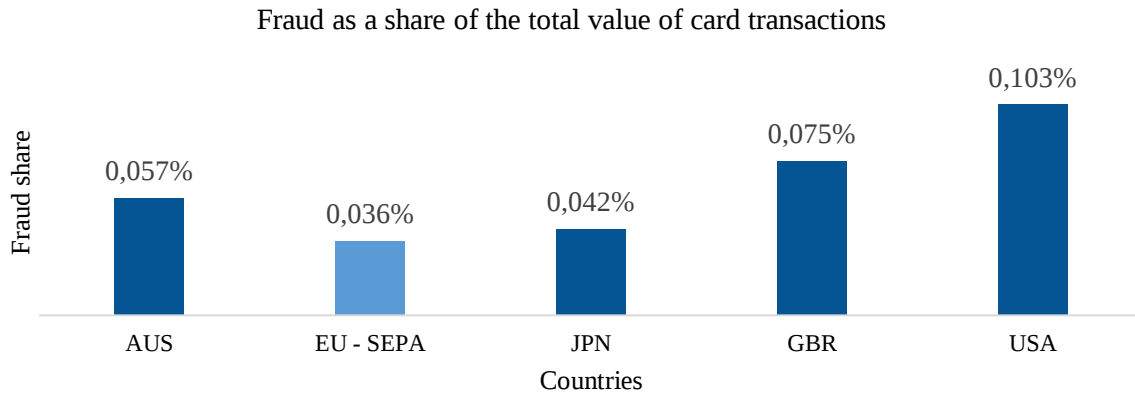


Figure 30: Fraud as a share of the total value of card transactions in Australia, the EU – SEPA, Japan, the UK, and the US

Source: Australian Payments Network, European Central Bank, Statista, UK Finance, and Nilson Report

Based on the objective mathematical method of the five intervals, the EU, together with Japan, got assigned an above average level (level 5), Australia a slightly above average level (level 4), and the UK an average level (level 3). More information on how these levels were attributed is disclosed in [Appendix 50](#) and [Appendix 51](#). Using this method solely, one should have positioned the US below average (level 1). However, considering that there is not a significant difference between the UK and the US, it does not make much sense that two levels separate these two countries. Simultaneously, India and Brazil were not considered when building the interval. The Aité and the IBM reports pointed out that Brazil ranked worse than the other regions in this analysis, including the US. Likewise, a slightly below average level (level 2) was attributed to the US and a below average level (level 1) to Brazil. Regarding India, as Aité positioned the country as being better than Brazil and the US and worse than the EU, it was reasonable to classify it as average (level 3). ([Appendix 52](#) and Figure 31)

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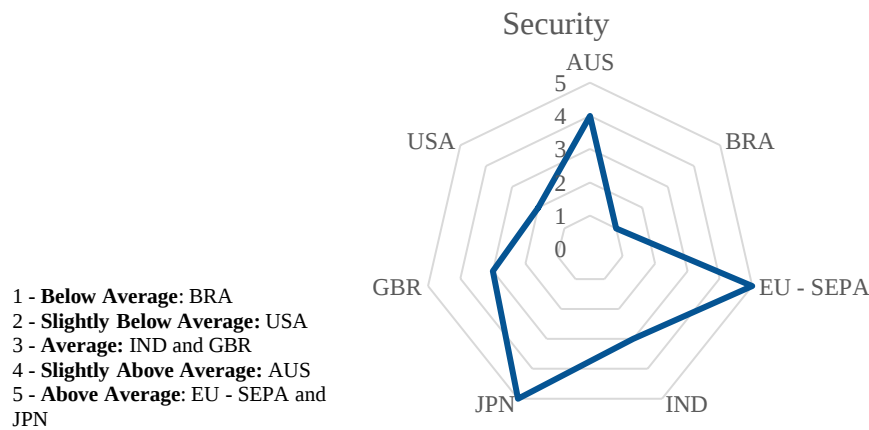


Figure 31: Radar graph on 2019 security levels for Australia, Brazil, the EU – SEPA, India, Japan, the UK, and the US

The abovementioned levels for each region allowed for a conclusion on the EU's security. The EU behaved above average in terms of security, outperforming the benchmark countries in fraud as a share of the total value of card transactions and in levels, except for Japan which is also above average (level 5). Therefore, accepting the initial assumption that card payment fraud is a representative indicator of a payments system's security, one can indeed state that the EU has the most secure payments system and so that it is efficient, security-wise.

5.1.5. Convenience

For the purpose of this analysis, convenience is defined as the quality of making payments more accessible and user-friendly for the payer by reducing the amount of effort or time required to execute it. It is assumed that an increased number of processes a customer needs to walk through to make payments decreases the convenience associated.

As referred in **Chapter 2**, as a requirement of the PSD2 to increase security, the SCA imposes an increased number of additional steps required to complete the authentication in a payment. Consequently, two dimensions are crucial in understanding how convenience is affected in the euro area: 1) evaluating how users are constrained on payment execution and 2) measuring the impact on efficiency by comparing the restrictions imposed on the selected countries.

Methodology and Limitations

Three types of payments were evaluated: contact and contactless card payments, and online payments. To compare the selected regions, data was used only for the contactless card and online payments since, for contact card payments, there are no significant convenience differences among countries. Therefore, the method explained at the beginning of the chapter was applied, attributing to the selected countries a number from 1 to 5, dependent on the level of convenience for each indicator.

For online payments, two sub-indicators were used, the frictionless payment rate and the authentication success rate. In the case of Japan, no data was found, limiting the comparative analysis to the other benchmark regions.

In the end, to calculate the final level of convenience, it was assumed a 50% importance for contactless card payments and 25% for each sub-indicator of online payments to achieve a final level of convenience and compare regions. Even though the importance of contactless and online payments differs in every region, evaluating the access to both methods was considered equally important.

Contact Card Payments

Contact card payments refer to physically inserting the card into the POS terminal. In 2015, after a considerable rise in the popularity of magnetic stripes, it became easy and inexpensive to counterfeit cards with simple and low-tech equipment. Thereupon, Europay, Mastercard, and Visa created EMV chip cards: Chip-and-PIN and Chip-and-Signature cards. While in Europe, Chip-and-PIN cards are widely used and accepted, in the US, most credit cards are Chip-and-Signature, and most debit cards are Chip-and-PIN.

Indeed, independently of the type of confirmation – PIN or Signature – the convenience level for contact card payments is similar worldwide. Moreover, because both technologies

incorporate a multi-factor authentication system that complies with SCA, the euro area countries did not have to create additional steps or requirements to successfully conclude a payment's authentication.

Contactless Card Payments

In contactless card payments, the card is physically present but it is not inserted in the POS terminal, using innovative technologies such as TAP-and-GO. As mentioned in **Chapter 1**, consumers have rapidly embraced contactless payment methods over the past years. In response to consumer demand, governments and issuers alike have established CVM limits corresponding to the maximum amount defined for which a second authentication method is not required, reducing the friction at the POS. Since these restrictions affect the time and effort required to complete a payment, it is considered that the higher the limit established, the higher the convenience level associated.

▪ Comparison Between Countries

Figure 32 presents the CVM limits for the regions in the study. All the limits were converted into euros with the exchange rates detailed in Figure 9. In this case, since the US is the only region which has no limit defined, the maximum level was attributed to it (level 5). The other regions were measured only between level 1 and level 4, using the same method. All the necessary calculations can be found in [Appendix 53](#) and [Appendix 54](#).

<i>Area</i>	Contactless Limit	Amount in EUR	Level Associated
AUS	200	126.34	4
BRA	200	33.99	1
EU-19	50	50.00	1
IND	5000	58.99	1
JPN	20000	154.45	4
GBR	100	115.36	3
USA	No limit	No limit	5

Figure 32: Comparison on CVM contactless limits

Source: US Payment Forum, Reserve Bank of India, Australian Payments Network, Mastercard, and Abecs

Group Part

Euro Area

Since the application of the PSD2 is mandatory, the euro area has taken a more aggressive approach to limit contactless payments, defining the CVM limit at €50. Even though the issuer entity may be able to settle lower limits, the overall amount or number of successive contactless transactions is capped at five transactions or €150. Furthermore, to lessen the inconvenience that contactless payments' multi-factor authentication causes to customers, PSPs can request exemptions from the SCA requirements for low-value transactions, low-risk transactions, recurring payments, and trusted seller status.

UK

The UK also needs to comply with the SCA requirements. The UK Financial Conduct Authority decided to increase the contactless limit even further to £100 in hopes that one could see more consumers using contactless card payments for higher value transactions such as purchasing fuel and weekly groceries without needing to use a chip and PIN (Global Payments 2021). The contactless limit has continuously increased since 2007, going from £10 to £45 in April 2020, and then raised to £100 to encourage contactless payments during the pandemic context.

US

In contrast with the European countries, the US government did not impose contactless restrictions, leaving it up to card networks and financial institutions to decide and implement their limits, impose restrictions, or ask for a PIN. The principal payment networks established different contactless CVM limitations in the US, as patent in Figure 33.

Payment network	Contactless CVM limit	CVM types supported over CVM limit
American Express	\$200.01	Signature or PIN request
Mastercard	\$100	Signature or PIN request
Visa	No limit is defined	Signature or PIN request

Figure 33: Contactless CVM limits for the US payment networks

Source: US Payments Forum

Brazil and India

Besides the EU, Brazil and India are the areas with the lowest defined contactless limits. The increasing preference for contactless payments is still recent, and governments are still aligning the limit levels, creating conditions to develop this payment method. As Mihir Ghandi, Partner & Leader – Payments Transformation, PwC, said: “Now people do not want to enter their PIN. So, by increasing the limit, almost 70-80 percent of the transaction will be covered at a Point of Sale terminal. Card companies will have to ensure that all their cards are enabled with contactless NFC technology [...] Much of transactions will now move to card transactions (Panda 2020).” In Brazil, the limit was updated in January 2021, the second time in seven months, to accommodate the growth in this payment method, which grew 478% between September 2019 and 2020.

Japan and Australia

Additionally, Japan and Australia have defined higher-value contactless limits, presenting higher adoption rates for these payment methods. Australia incorporated the SCA rules and adapted them to the Australian Payments Networks’ *CNP Fraud Mitigation Framework*, being more flexible on the choice of what operations were to be applied the SCA rules, defining a higher-value contactless limit, and having the best percentage of frictionless transactions amongst the comparison countries.

Online Purchases

To compare the convenience levels across different countries, a study performed by Ravelin, with data from the second semester of 2021, was used, focusing on two indicators: 1) authentication success rate, and 2) frictionless payments rate. The authentication success rate measures the percentage of online payments for which the authentication process is concluded successfully. The frictionless payments rate measures the percentage of payments that take less than five seconds to complete the authentication transaction.

The analysis considers only payments made with 3DS technology, being an additional layer of security for online transactions created by Visa. It is already incorporated and globally accepted by the most well-known payment networks: *Verified by Visa*, *Mastercard SecureCode*, and *American Express Safekey*.

When cardholders enter their payment information in a payment gateway where 3DS is enabled, they will be redirected to a particular site or embedded frame. In addition, cardholders must correctly answer a security question (password or PIN) to verify their identity. The issuing bank will decline the transaction if the cardholder does not answer correctly.

The first version of this technology, 3DS 1.0, was raising difficulties for consumers, creating friction in payment processing. Consequently, two other versions of this technology were created – 3DS 2.1 and 3DS 2.2 – to improve the convenience of the authentication and provide a smoother user experience. These make the risk analysis more efficient and the payments frictionless to merchants and cardholders, allowing for several improvements such as 1) sending more data to the issuer bank, 2) being more adaptable to a broader range of devices, and 3) enabling dynamic authentication through biometrics and token-based authentication methods.

▪ Comparison Between Countries

Figure 34 presents data for the authentication success rate and the frictionless payments rate for all regions. Additional calculations can be found on [Appendix 55](#).

Countries	Authentication Success Rate			Frictionless Payments Rate	
	3DS 1.0	3DS 2.1	Authentication Level	3DS 2.1 *	Frictionless Level
AUS	92%	99%	5	93%	5
BRA	15%	27%	1	1%	1
EU - 19	99%	75%	4	38%	2
IND	99%	43%	2	6%	1
JPN	N.A.	N.A.	N.A.	N.A.	N.A.
GBR	97%	90%	5	64%	4
USA	91%	98%	5	40%	3

Figure 34: Comparison on Authentication Success Rate and Friction

Source: Ravelin – Global Payment Regulation & Authentication Report 2021 retrieved from: <https://pages.ravelin.com/global-payment-regulation-map>

It is not evident why the differences between countries are so sharp. Brazil and India are less developed than the other countries in authentication success and frictionless rates. Both countries require two-factor authentication on online payments and have lower than average percentages of payments made by card, which affect the acceptance rates for online payments and consequently worsen the authentication success rate and increase the friction on payments. The technological development and regulatory framework make Australia and US the regions with the highest authentication success rates. The implemented risk-analysis system in Australia, in which only the high-risk transactions are obliged to follow the SCA, contributes to a higher percentage of frictionless payments than in the US.

The UK and the euro area presented lower authentication success rates for 3DS 2.1 than for 3DS 1.0, with a significant difference for the euro area, where one out of four transactions were not authenticated. Since the euro area aggregates countries with different consumer preferences, the SCA requirements application affects the EU's countries differently, decreasing the authentication level. The same reasoning applies to frictionless payments, with the UK presenting a payment infrastructure that is faster and more efficient, making the process frictionless.

Group Part

Is the EU's Payment System Efficient, Convenience-Wise?

Using the method explained as a proxy to evaluate convenience, the EU has one of the less convenient payment systems.

However, it is crucial to understand that convenience and security always go together. If, on the one hand, it is important for customers and merchants to have a convenient system that reduces the amount of effort or time to process a payment, the flexibilization of the process increases the exposure to risks that can affect the security of the system. There is no perfect formula to find this balance, and it can be concluded that different regions choose distinct strategies and priorities to improve efficiency.

<i>Countries</i>	Contactless Payments	Authentication Success Rate	Frictionless Payment Rate	Convenience level
AUS	4	5	5	5
BRA	1	1	1	1
EU – 19	1	4	2	2
IND	1	2	1	1
JPN	4	N.A.	N.A.	4
GBR	3	5	4	4
USA	5	5	3	5

Figure 35: Final convenience levels for Australia, Brazil, the EU, India, Japan, the UK, and the US

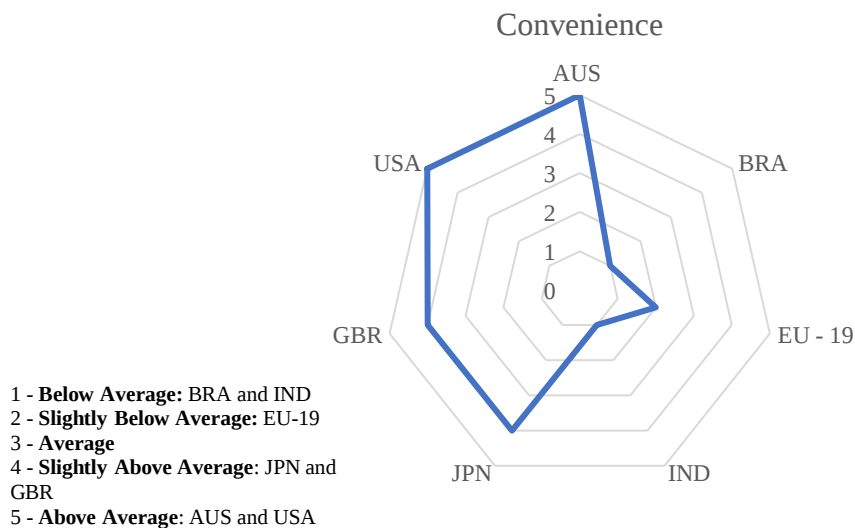


Figure 36: Radar graph on 2019 convenience levels for Australia, Brazil, the EU – 19, India, Japan, the UK, and the US

Compared with the other regions, only Brazil (level 1) and India (level 1) have worse and unsatisfactory payment systems in terms of convenience. Since these countries have a lower

usage level for contactless card and online payments and a similar level of regulatory constraints as Europe, one can justify this positioning. Contrarily, the US and Australia were determined to be the most convenient systems. For the US, the lack of legislation and limits definition, as well as the flexibility and adaptability in Australia's systems, are crucial in sustaining this positioning. Regarding the UK, the fact that it is subject to the same SCA requirements in contactless payments as the EU negatively affects the convenience level. However, the efforts made by the country to respond to the changes in consumer preferences put the UK at a higher level of convenience. Finally, although the data found suggests that Japan is slightly above average in terms of its level of convenience (level 4), the analysis is limited to contactless payments and does not include the other assessed payment methods. (Figure 35 and Figure 36)

5.1.6. Efficiency Assessment Conclusion

It is impossible to state whether Europe, for which the EU is a proxy, is efficient in absolute terms. An absolute efficiency definition ignores consumer preferences. Consumers from different nationalities often value the same set of parameters differently. For example, while some consumers value a fast payment system more, others prefer a low-cost one. Therefore, the concept of efficiency is different for all the regions in the analysis. Likewise, one can only execute an efficiency inference by resorting to a comparison system, i.e. whether the EU is efficient in each parameter relative to the benchmark countries.

It is not possible to aggregate the conclusions of all the parameters and reach a majority position that will determine overall efficiency, as there are trade-offs between some of them. A better result in one of them can imply a worse result in another, existing simultaneous opposite forces impacting efficiency. The most evident and proven trade-off takes place between convenience and security. Without SCA, transactions are easier, faster, and consequently more convenient for the payer, but the risk of fraud is much higher. The different regions' systems have distinct

Group Part

approaches to this trade-off. Some, such as the European one, prefer security in detriment of convenience, while others, such as the American one, choose the opposite. Other trade-offs could be theoretically mentioned, but there is no evidence backing up their existence and impact on the payment systems' efficiency. Consequently, the procedure followed in evaluating the EU's payment system efficiency was to solely assess the EU's relative performance in each parameter without any final aggregation.

The efficiency assessment analysis in question culminates in identifying in which parameters the EU has a competitive advantage or disadvantage. According to Figure 37 and Figure 38, the EU has a competitive advantage in security due to its above average performance (level 5) and a competitive disadvantage in convenience as a result of its slightly below average performance (level 2). As just mentioned, this can be explained by the trade-off verified between these two parameters. In the remaining parameters, this is cost, speed, and availability, the EU displays an average performance (level 3), indicative of no competitive advantages or disadvantages.

	Cost	Speed	Availability	Security	Convenience
AUS	4	3	3	4	5
BRA	3	3	3	1	1
EU	3	3	3	5	2
IND	5	4	2	3	1
JPN	N.A.	3	3	5	4
GBR	5	3	3	3	4
USA	3	3	3	2	5

Figure 37: Efficiency analysis for Australia, Brazil, the EU, India, Japan, the UK, and the US

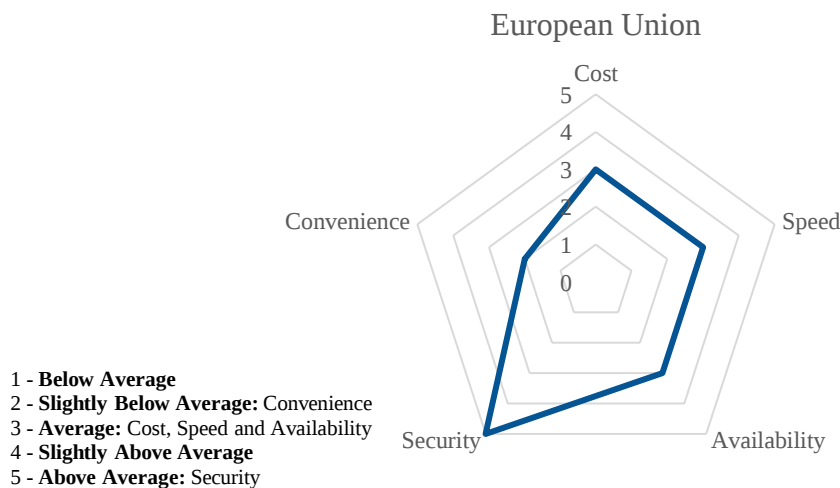


Figure 38: Radar graph for the EU's efficiency by parameter

All in all, the EU is generally as efficient as the average benchmark country, though it can improve and converge with the UK and India, respectively in cost and speed. The UK is the example to follow in consumer charges, and India in LVPS's working hours and instant transfers' penetration in the payment system.

5.2. Barriers to the EU's Payment System Efficiency

In this study, three barriers to the EU's payment system efficiency were identified, namely 1) the fragmentation of the EU's payment system, 2) the high dependence on non-European solutions, and 3) the misalignment of European banks' incentives with the EU.

1) Fragmentation of the EU's payment system: When looking at the EU's fragmentation, one means the retail payment system. The wholesale payment system, being much more integrated, does not face this problem as severely, while for the retail payment system the same cannot be said. Fragmentation can be decomposed into three dimensions: operational challenges, lack of convergence, and the no interoperability among domestic schemes. Operational challenges concern the fact that the EU is composed of twenty-seven countries with different opinions, cultures, and languages, which makes it difficult to reach a consensus and decision-making. As for the lack of convergence, each European country is in its development stage, making it challenging to create rules applicable to all. At the same time, countries will have different receptiveness rates to each decision being discussed, and the same rule will not have the same impact on all of them. Regarding the nonexistence of interoperability among domestic schemes, the proliferation of domestic scheme(s) and instant transfer system(s) creates confusion among consumers on which option to choose and jeopardizes the implementation of common European infrastructures. Fragmentation is a barrier to the EU's payment system efficiency, but the EU is already considering it and

thinking of suggestions to quell it. As argued by the EC, a fully integrated instant payment system in the EU is necessary to reduce the risks and vulnerabilities in retail payment systems. According to the ECB, there is a need to create a SEPA version for cards and online and mobile payments. This will eliminate the residual fragmentation hampering or even preventing European customers from using their national payment solutions in all European markets.

- 2) Dependence on non-European solutions:** According to the ECB, the European retail payment system is characterized by a high degree of dependence on non-European solutions. Non-European solutions can be understood as foreign PSPs operating in Europe that aggregate a significant market share and do not have direct European competition. The two great American card schemes, Visa and Mastercard, are an example of that. A positive correlation between dependence and digitalization is observed in the EU, meaning that the more digital the payments landscape becomes, the more dependent the EU gets on non-European solutions. This was observed when the payments landscape switched from traditional payment instruments to card payments and from the latter to purely digital forms integrated into smartphones or digital wallets. This can be a problem, as it puts Europe's digital sovereignty at risk, i.e. Europe's ability to act independently in the digital world. Furthermore, an increased dependence makes Europe more vulnerable and may aggravate concerns about security, particularly resilience (e.g. cyber-resilience), data privacy, and competitiveness (e.g. decreased incentives to innovate and downward pressure on prices).
- 3) Misalignment of European banks' incentives with the EU:** Europe has been making much effort, and significant progress can be seen in preparing the European payment system for the future. The implementation of the SCT Inst scheme is one example. Despite the EU's

desire to make instant payments the “new normal,” European banks charge a significant amount for this specific payment service, being it one of the most expensive in the benchmark. By charging this service, customers are disincentivized to use it. European banks’ incentives are misaligned with the EU’s strategy, primarily because part of their revenues accrue from card payments, disincentivizing the free offer of instant transfers. A significant part of the EU payment system is under the control of banks, so if the EU wants its vision to be pursued, it must align banks’ incentives with it.

5.3. Possible Improvements to the EU’s Payment System Efficiency

A payment system is always dependent on internal and external factors. Therefore, the idea of having a system 100% efficient is unfeasible since it is an alive mechanism that needs constant adaptations. Moreover, three enhancement sources must be considered for the EU’s system: the ones based on other countries’ more efficient solutions, improvements specific to the EU’s system that require tailor-made solutions, and solutions that could be applied to all payment systems, mainly through technological innovations. Consequently, the improvements identified were the following:

- 1) Correction on interchange fee regulation:** The creation of a cap on interchange fees aimed to reduce the costs merchants pay for accepting card payments. However, even with the decrease in the interchange fee, payment networks were able to revert the situation by increasing the network fee, another MSC component. Therefore, to reduce the costs paid by merchants and boost the system’s efficiency, a regulation update is recommended so that the cap is focused on the MSC.

2) Rebalance the convenience and security trade-off: As demonstrated by the analysis, EU's systems give particular focus and effort to the system's security protection, being the user's convenience, not the primary concern. However, to be competitive, Europe should rebalance its priorities, finding an intermediate solution in which convenience is improved without affecting the system's security. Our analysis suggests that Japan overcame this shortcoming by having an above performance in terms of security (level 5) and slightly above the average in convenience (level 4). Furthermore, implementing new technologies, such as biometric technologies, helped Japan to boost the payment system's security while not downgrading its convenience (The Government of Japan 2022). As such, different solutions may be taken by the EU, such as increasing CVM contactless limits, like the UK is doing, or the increasing acceptance of biometric technology resources. Those decisions would improve consumer convenience, expecting not to create a major difference in the system's security level.

3) Reduction of the dependence on foreign network schemes: With the exponential use of card payment, schemes such as Visa and Mastercard have assumed a significant role in the system. Their incumbent and market share dominance positioning gives them the competitive advantage of accessing and analyzing all payment data. As a result, schemes are always one step ahead relative to the other players, using the data for numerous purposes: 1) innovation, 2) reselling, and 3) consultancy.

As a trial to face this constraint, Europe has already tried to create its common payment network. However, the attempts were not implemented successfully since national card schemes and banks did not see a viable business case in the short term. As a consequence, if the EU implements a regulation that obliges schemes to share these data with the ECB, schemes' power advantages would be suppressed.

- 4) Increase the adoption of instant payment solutions:** The EU's goal is to have an instant payment system common to its members and interoperable with domestic infrastructures. However, mainly due to the misalignment between banks and the EU, this objective is still far from being accomplished, resulting in the lack of adoption of this common system (SCT Inst). Therefore, more incentives or regulations are required for banks to offer this payment solution. Moreover, by building a strong and cohesive system, which connects all national instant payment solutions, the EU would not only be boosting the speed of payments considerably but also creating an alternative system to the card schemes' oligopoly. In that sense, the system's efficiency could significantly improve as instant payments allow a faster and cheaper option compared to other existing solutions.
- 5) Promote homogeneity in reporting:** It is important to emphasize that the EU is the leader in regulation, data availability and reporting compared to other countries. However, there are still some asymmetries in information for the different agents involved, affecting the system's efficiency. The different national institutions do not follow specific rules or standards regarding availability, data selection, periodicity, and formatting in data communication. In truth, there are already designated European institutions that fight against this problem, such as the ECB and the EPC, but there is still a margin for improvement. Similarly to other sectors, such as the financial system, in which the reporting systems were standardized, a similar regulation would improve the system's efficiency.
- 6) Increase transparency and education on cost assessment:** From the consumer's view, the existence of bundled banking packages increases the difficulty of the cost analysis, making it challenging to compare the card fees across different banks. To benefit the consumer, it would be important to understand the explicit costs of each service included in

the bundle. Additionally, from the merchant's view, it can be hard to fully understand the benefits of the unblended pricing scheme, due to the complexity of a payment transaction. With the blended scheme, merchants know they always pay the same fixed fee per transaction, making it easier to predict the costs of accepting payments at the end of the month. Merchants with poor financial literacy will tend to choose the pricing scheme that is easiest to understand, even though it may not be transparent. Increasing financial literacy would provide merchants the necessary tools to understand the costs borne and how these can be reduced.

- 7) Implementation of the Digital Euro:** Even though the Digital Euro is a project still under development, it has the potential to boost the ECB's influence in digital payments while increasing the speed, convenience, and security of retail payments (European Central Bank 2022). CBDCs are set as the future of monetary systems, as they will include some of the perks of existing digital currencies, whilst keeping the users' interests forefront (Bank for International Settlements 2022). In this sense, EU's citizens appreciate the existence of a risk-free digital currency backed by the ECB as an alternative to cryptocurrencies (Kantar Public 2022). Furthermore, both this project and instant payments are part of the EU's vision for the future of its payment system, as they 1) reduce the EU's dependency on foreign companies, such as Visa and Mastercard, 2) protect the system against the rise of digital currencies, and 3) can be more efficient than traditional payment methods.

Conclusion

Moving beyond the historical dominance of cash, the emergence of cashless payments during the second half of the twentieth century was a remarkable transformation of the European payment system, with debit and credit cards assuming increasing importance. Lately, technological developments have shaped the sector, creating innovative solutions that have compelled the European system to adapt and create new infrastructures that guarantee the system's efficiency. Consequently, the EU institutions' intervention, through the implementation of Regulations and Directives, as well as the existence of international standards, has effectively mitigated risks and incorporated new trends.

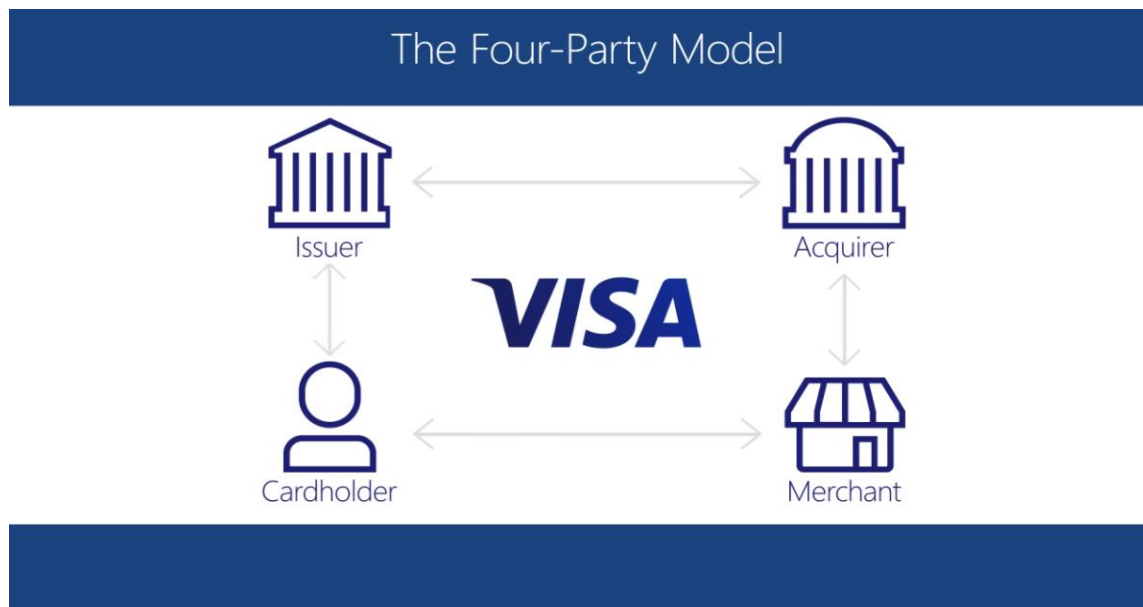
Compared with the analysis' benchmark regions, the EU arises as having a highly efficient system in terms of security, with a consequent convenience level for the user below the average. In terms of cost, speed, and availability, the EU system stands in a similar position as the compared regions, not presenting competitive advantages.

Furthermore, macroeconomic, social, and political factors can substantially impact the system. In Europe, the fragmentation between countries, the dependence on non-European networks, and the fact that some players have a misalignment in incentives make the objective of having an efficient payment system an additional challenge.

All things considered, a set of improvements can still be implemented. An increase in transparency and a reduction in the dependence on foreign networks can lead to an even higher level of efficiency. Simultaneously, a commitment to adopting disruptive methods, such as instant payment solutions and the Digital Euro, can play a fundamental role in making the European payment system even more efficient, robust and independent.

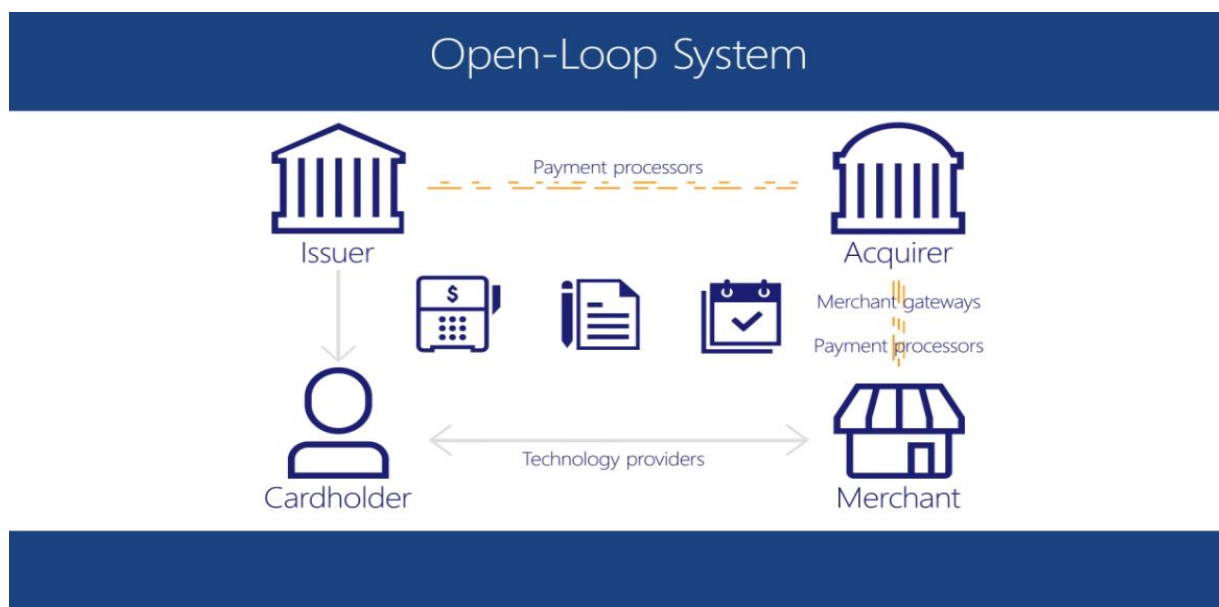
Appendix

Appendix 10



Legend: The Four-Party Model scheme representation

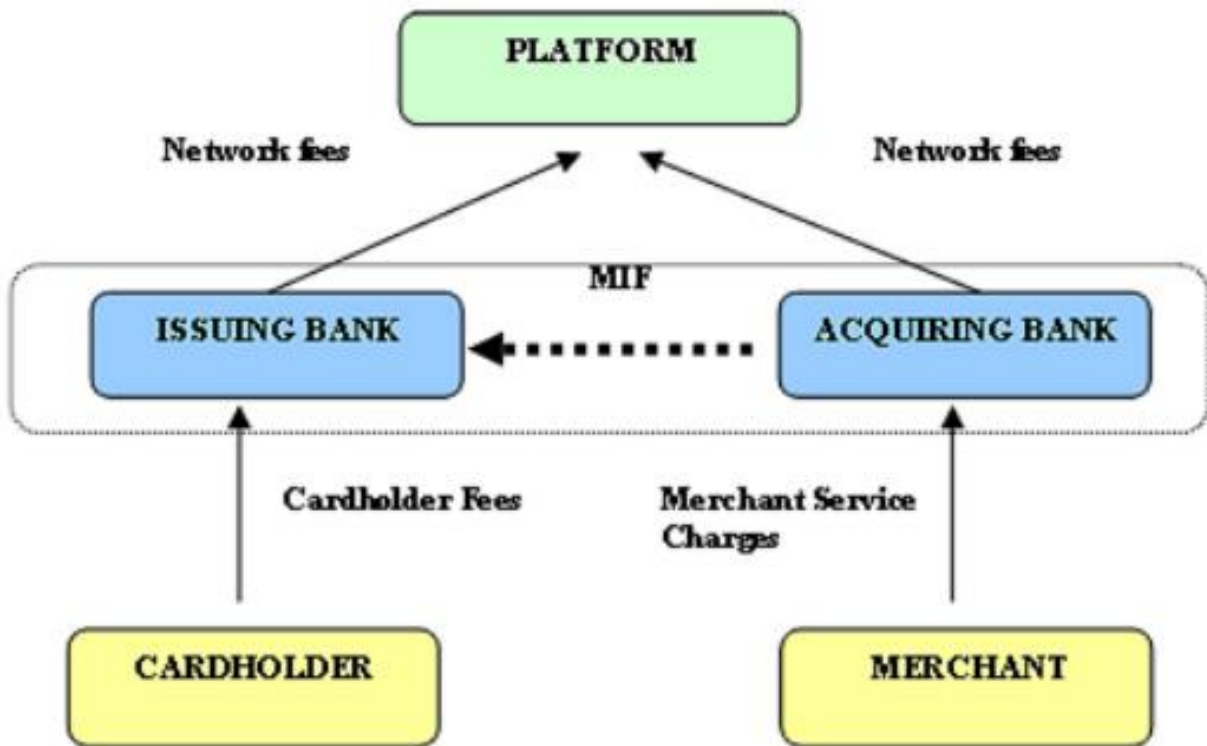
* Note: Card scheme networks, not only Visa but all existing ones, lay in the center of the Four-Party Model, serving as a connection between the parties.



Legend: The Open-Loop System Model scheme representation

Source: Visa Partner. Retrieved from <https://partner.visa.com/site/learn/overview-of-payments.html>

Appendix 11



Legend: Players' fees involved in the payment transaction process

Source: European Commission. Retrieved from:

https://ec.europa.eu/commission/presscorner/detail/de/MEMO_13_719

Appendix 12

Intra Europe EEA¹ | Multi-lateral Interchange Fees

Consumer		
Product	Fee Type	General
Visa Consumer Debit	Contactless	0.20%
Visa Consumer Prepaid	Secure ² Non-Secure	
V PAY Debit	Contactless	0.20%
V PAY Prepaid	Secure Non-Secure	
Visa Consumer Credit	Contactless	0.30%
Visa Consumer Deferred Debit	Secure Non-Secure	

Commercial				
Product	Fee Type	General	Government Payments ³ and Money Services ⁴	Charity ⁵
Visa Business Debit	EMV Chip (Incl. Contactless)	1.30%	1.30% (capped at €1.50)	1.30% (capped at €0.50)
	Electronic Commerce	1.55%	1.55% (capped at €1.50)	1.55% (capped at €0.50)
	Standard	1.65%	1.65% (capped at €1.50)	1.65% (capped at €0.50)
Visa Business Prepaid	EMV Chip (Incl. Contactless)	1.30%, minimum €0.35	1.30%, minimum €0.35 (capped at €1.50)	1.30%, minimum €0.35 (capped at €0.50)
	Electronic Commerce	1.55%, minimum €0.35	1.55%, minimum €0.35 (capped at €1.50)	1.55%, minimum €0.35 (capped at €0.50)
	Standard	1.65%, minimum €0.35	1.65%, minimum €0.35 (capped at €1.50)	1.65%, minimum €0.35 (capped at €0.50)
Visa Business Credit	EMV Chip (Incl. Contactless)	1.30%	-	-
Visa Business Deferred Debit	Electronic Commerce	1.55%	-	-
	Standard	1.65%	-	-
Visa Business Credit - Small Market Expense	Standard	0.30%	-	-
Visa Platinum Business Debit	EMV Chip (Incl. Contactless)	1.55%	1.55% (capped at €1.50)	1.55% (capped at €0.50)
Visa Infinite Business Debit	Electronic Commerce	1.80%	1.80% (capped at €1.50)	1.80% (capped at €0.50)
	Standard	1.90%	1.90% (capped at €1.50)	1.90% (capped at €0.50)
Visa Platinum Business Credit	EMV Chip (Incl. Contactless)	1.55%	-	-
Visa Infinite Business Credit	Electronic Commerce	1.80%	-	-
	Standard	1.90%	-	-
Visa Corporate	EMV Chip (Incl. Contactless)	1.55%	-	-
	Electronic Commerce	1.80%	-	-
	Standard	1.90%	-	-
Visa Corporate - Large Market Enterprise	Standard	0.30%	-	-

Individual Part: Ana Mota

Visa Purchasing	EMV Chip (Incl. Contactless)	1.55% ⁶	-	-
	Electronic Commerce	1.80% ⁶	-	-
	Standard	1.90% ⁶	-	-
	Large Ticket Program 1 ⁷	1.00% + €60.00	-	-
	Large Ticket Program 2 ⁷	0.75% + €98.00	-	-

¹ Applicable to EEA issued Visa cards transacting at EEA based merchants (in a different country).

For consumer interchange only, EEA includes the territories of Guadeloupe, French Guiana, Martinique, Réunion, Mayotte and Saint-Martin.

Effective 1 September 2016, the interchange fees applicable to Visa consumer card transactions, where the merchant and its acquirer are located in different EEA countries, is changing.

For in-country consumer card transactions, where both the cardholder and the merchant outlet are within the same EEA country, a cross-border acquirer may choose either:

- the intra Visa EEA interchange rate, or
- the rate equivalent to the respective domestic rate (subject to the fee caps specified in Chapter II of the Interchange Fee Regulation (IFR))

² Comprises of EMV Chip, Visa Secure, or other equivalent secure Visa technology which may be developed in the future.

³ Government Payments: Merchant Category Code (MCC) 9311—Tax Payments, MCC 9399—Government Services

⁴ Money Services: MCC 6012—Financial Institutions; MCC 6211—Security Brokers/Dealers

⁵ Charity: MCC 8398—Charitable Social Service Organizations

⁶ Visa Purchasing acquirers may receive an additional interchange incentive of €0.50 if they submit the transaction with additional data: "Visa Global Invoicing System and Line Item Detail" (VGS/ILM)

⁷ For Visa Purchasing Cards only: Large Ticket Program 1 is for transactions greater than €7,500 and Large Ticket Program 2 is for transactions greater than €15,000

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Legend: Intra Europe EEA consumer and commercial cards' interchange fees



Inter Europe EEA¹ | Multi-lateral Interchange Fees

Consumer		
Product	Fee Type	General
Visa Consumer Debit & Visa Consumer Prepaid	Card-Present ²	0.20%
	Card-Not-Present ³	1.15%
Visa Consumer Credit⁴ & Visa Consumer Deferred Debit	Card-Present	0.30%
	Card-Not-Present	1.50%

¹ Applicable to Visa interchange fees for transactions on consumer cards issued outside of the European Economic Area (EEA) occurring at merchants located in the EEA. Applicable only in respect of consumer cards. EEA consists of the 27 EU Member States plus Iceland, Liechtenstein and Norway, and includes the French European Union Outermost Region territories of Guadeloupe, French Guiana, Martinique, Mayotte, Réunion and Saint-Martin

² Card-present transactions are where (i) cardholder and card are present at either the merchant outlet or are with the merchant's physical POS device at the time of payment transaction, and (ii) the cardholder's issuer-provisioned payment credentials are present and electronically read by the merchant's physical POS device.

³ Card-not-present transactions are all transactions other than card-present transactions.

⁴ Includes charge cards.

Effective 19 October 2019

Legend: Inter Europe EEA consumer cards' interchange fees

Source: Visa. Retrieved from <https://www.visa.co.uk/about-visa/visa-in-europe/fees-and-interchange.html#2>



Intra-EEA - Intercountry Interchange Fees

Valid From:
09-Dec-15

Consumer Card Interchange Fees

Payment Product	Fee Tier	General
Mastercard Consumer Credit	Contactless (1)	0.30%
	Chip	0.30%
	Enhanced Electronic	0.30%
	Merchant UCAF	0.30%
	Full UCAF	0.30%
	Masterpass Wallet	0.30%
	Base	0.30%
	Purchase at ATM (2)	0.30%
	Purchase at ATM (late presentment) (2)	0.30%
Mastercard Consumer Debit Debit Mastercard Consumer Mastercard Consumer Prepaid	Contactless (1)	0.20%
	Chip	0.20%
	Enhanced Electronic	0.20%
	Merchant UCAF	0.20%
	Full UCAF	0.20%
	Masterpass Wallet	0.20%
	Base	0.20%
	Purchase at ATM (2)	0.20%
	Purchase at ATM (late presentment) (2)	0.20%
Maestro Consumer Maestro Consumer Prepaid	Contactless (1)	0.20%
	Chip	0.20%
	Secure e-commerce	0.20%
	PIN-verified	0.20%
	Signature verified	0.20%
	Mail Order /Telephone Order (3)	0.20%
	Masterpass Wallet	0.20%
	Chip - late presentment	0.20%
	Purchase at ATM (2)	0.20%
	Purchase at ATM (late presentment) (2)	0.20%

(1) For transaction amounts less than or equal to EUR 25.00

(2) Available only for MCCs 4814, 4900, 6050, 6051

(3) Credit refund transactions only

Legend: Intra Europe EEA consumer cards' interchange fees



Intra-EEA - Intercountry Interchange Fees

Valid From:
22-Jan-21

Commercial Card Interchange Fees

Payment Product	Fee Tier	General
Mastercard Corporate Mastercard Electronic Corporate Debit Mastercard for Business Premium Mastercard World Business	Contactless (1)	1.50%
	Chip	1.50%
	Enhanced Electronic	1.60%
	Masterpass Wallet	1.60%
	Base	1.90%
	Incentive (5)	-0.30%
	Purchase at ATM	1.50%
	Purchase at ATM (late presentment)	1.90%
Mastercard Corporate Prepaid	Contactless (1)	1.80%
	Chip	1.80%
	Enhanced Electronic	1.80%
	Masterpass Wallet	1.80%
	Base	1.90%
	Incentive (5)	-0.30%
	Purchase at ATM	1.80%
	Purchase at ATM (late presentment)	1.90%
Mastercard BusinessCard Mastercard Professional Card Mastercard Electronic BusinessCard Mastercard Executive BusinessCard Mastercard Corporate Executive Card Debit Mastercard for Business	Contactless (1)	1.25%
	Chip	1.25%
	Enhanced Electronic	1.35%
	Masterpass Wallet	1.35%
	Base	1.65%
	Purchase at ATM	1.25%
	Purchase at ATM (late presentment)	1.65%
	Incentive (5)	-0.30%
Mastercard FleetCard	Contactless (1)	1.25%
	Chip	1.25%
	Enhanced Electronic	1.35%
	Masterpass Wallet	1.35%
	Base	1.65%
	Purchase at ATM	1.25%
	Purchase at ATM (late presentment)	1.65%
	Large Ticket Level 1 (2)	1.00% + EUR 20.00
	Large Ticket Level 2 (3)	0.75% + EUR 45.00
	Incentive (5)	-0.30%
Debit Mastercard Prepaid Commercial	Contactless (1)	1.25%
	Chip	1.25%
	Enhanced Electronic	1.35%
	Masterpass Wallet	1.35%
	Base	1.65%
	Purchase at ATM	1.25%
	Purchase at ATM (late presentment)	1.65%
	Incentive (5)	-0.30%
Mastercard Purchasing Card	Contactless (1)	1.25%
	Chip	1.25%
	Enhanced Electronic	1.35%
	Masterpass Wallet	1.35%
	Base	1.65%
	Large Ticket Level 1 (2)	1.00% + EUR 20.00
	Large Ticket Level 2 (3)	0.75% + EUR 45.00
	Incentive (5)	EUR -0.50
	Purchase at ATM	1.25%
	Purchase at ATM (late presentment)	1.65%

Individual Part: Ana Mota

Maestro Small Business	Contactless (1)	1.25%
	Chip	1.25%
	Secure e-commerce	1.50%
	PIN-verified	1.35%
	Signature verified	1.65%
	Mail Order /Telephone Order (4)	1.50%
	Masterpass Wallet	1.50%
	Chip - late presentment	1.65%
	Purchase at ATM	1.25%
	Purchase at ATM (late presentment)	1.65%
Maestro Prepaid Commercial	Contactless (1)	0.40% + EUR 0.05
	Chip	0.40% + EUR 0.05
	Chip - late presentment	0.75% + EUR 0.05
	PIN-verified	0.50% + EUR 0.05
	Signature verified	0.75% + EUR 0.05
	Masterpass Wallet	1.50%
	Secure e-commerce	1.05% + EUR 0.05
	Mail Order /Telephone Order (4)	1.05% + EUR 0.05
	Purchase at ATM	0.40% + EUR 0.05
	Purchase at ATM (late presentment)	0.75% + EUR 0.05

(1) For transaction amounts less than or equal to EUR 25.00

(2) For transaction amounts more than EUR 3,000.00

(3) For transaction amounts more than EUR 10,000.00

(4) Credit refund transactions only

(5) Please review latest Interchange and Service Fees Manual—Europe Region", section "Intra-EEA Fallback Interchange and Service Fee Rates" for conditions to apply

Legend: Intra Europe EEA commercial cards' interchange fees



EEA inbound cross-border consumer transactions Interchange Fees

Valid From:
19/10/19

Consumer Card Interchange Fees

Payment Product	Fee Tier	General
Consumer Credit	EEA Credit Card Present Rates	0.30%
Consumer Debit	EEA Debit Card Present Rates	0.20%
	EEA Credit Card Not Present Rates	1.50%
	EEA Debit Card Not Present Rates	1.15%

Rates applicable to Consumer POS transactions, where the merchant is located in the EEA, and the issuer is located outside of the EEA;

Legend: Inter Europe EEA consumer cards' interchange fees

Source: Mastercard. Retrieved from <https://www.mastercard.com/europe/en/regulatory/european-interchange.html>

Appendix 23

	Debit Card Usage (in %)	Credit Card Usage (in %)
AUS	41%	35%
BRA	22%	35%
EU	40%	19%
IND	-	-
JPN	-	-
GBR	45%	28%
USA	30%	40%

Legend: Debit and credit card usage in each region as of 2021 considering POS transactions

Source: FIS. Retrieved from: <https://offers.worldpayglobal.com/rs/850-JOA->

[856/images/ENGPR2022.pdf?mkt_tok=ODUwLUUpQSO4NTYAAAGHHy8o3Gz29yVxu8CO8bZcWOJfVlb6NKlwaShVFdWbfgV55k00qWm_eimM8R7YYNcBRUOEAXIqSpMMLFTOLr1CBRJoXjY9OBId_N1F1bMx_jgcsws](https://offers.worldpayglobal.com/rs/850-JOA-856/images/ENGPR2022.pdf?mkt_tok=ODUwLUUpQSO4NTYAAAGHHy8o3Gz29yVxu8CO8bZcWOJfVlb6NKlwaShVFdWbfgV55k00qWm_eimM8R7YYNcBRUOEAXIqSpMMLFTOLr1CBRJoXjY9OBId_N1F1bMx_jgcsws)

Appendix 24

EU	USA	UK	Australia	Japan	Brazil	India
Santander	JP Morgan Chase	Barclays	CommBank	MUFG Bank	Itaú Unibanco	State Bank of India
BNP Paribas	Bank of America	Lloyds	ANZ	Sumitomo Banking Corporation	Banco Bradesco	HDFC Bank
Société Générale	Wells Fargo	HSBC	Westpac	Japan Post Bank Co.	Banco do Brasil	ICICI Bank
Deutsche Bank	Citi Bank					
BBVA	US Bank					

Legend: Top commercial banks of each region ranked by total assets in 2021

Source: Orbis database

Appendix 25*Australia*

	CommBank	ANZ	Westpac
Annual management fee Account	\$48.00	\$0.00	\$60.00

(Converted to euro)	CommBank	ANZ	Westpac
Annual management fee Account	€ 30.32	€ 0.00	€ 37.90

Brazil

	Itaú	Banco Bradesco	Banco do Brasil
Annual credit card fee	R\$ 0.00	R\$ 0.00	R\$ 0.00

(Converted to euro)	Itaú	Banco Bradesco	Banco do Brasil
Annual credit card fee	€ 0.00	€ 0.00	€ 0.00

Group Part

EU

	Santander	BNP Paribas	Société Générale	Deutsche Bank	BBVA
Annual account management fee	€ 0.00	€ 77.52	€ 24.00	€ 82.80	€ 96.00

UK

	Barclays	Lloyds	HSBC
Annual account management fee	£0.00	£0.00	£0.00

<i>(Converted to euro)</i>	Barclays	Lloyds	HSBC
Annual account management fee	€ 0.00	€ 0.00	€ 0.00

US

	JP Morgan Chase	Bank of America	Wells Fargo	Citi Bank	US Bank
Annual credit card fee	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00

<i>(Converted to euro)</i>	JP Morgan Chase	Bank of America	Wells Fargo	Citi Bank	US Bank
Annual credit card fee	€ 0.00	€ 0.00	€ 0.00	€ 0.00	€ 0.00

Legend: Annual account management fees and annual credit card fees by bank and by region (in the original currency and converted to the base currency)

Source: CommBank of Australia, ANZ, Westpac, Banco Itaú, Banco Bradesco, Banco do Brasil, Santander, BNP Paribas, Société Générale, Deutsche Bank, Barclays, Lloyds, HSBC, JP Morgan Chase, Bank of America, Wells Fargo, Citi Bank and US Bank

Appendix 26

Lower Limit	€ 0.00
Higher Limit	€ 56.06
Each level interval	€ 11.21

Legend: Limit calculation for card payments

Appendix 27

	<i>Card Payments</i>		
Valuation	Lower Limit	Higher Limit	Number
Above Average	€ 0.00	€ 11.21	5
Slightly Above Average	€ 11.21	€ 22.43	4
Average	€ 22.43	€ 33.64	3
Slightly Below Average	€ 33.64	€ 44.85	2
Below Average	€ 44.85	€ 56.06	1

Legend: Limit definition for card payments

Appendix 28*Brazil*

	Instant transfers (Pix)	Regular Transfers (DOC /TED)
Itaú	R\$ 0.00	R\$ 11.10
Banco Bradesco		N.A.
Banco do Brasil		R\$ 11.80

<i>(Converted to euro)</i>	Instant transfers (PIX)	Regular Transfers (DOC /TED)
Itaú	€ 0.00	€ 1.89
Banco Bradesco		N.A.
Banco do Brasil		€ 2.01

EU

European Banks	<i>Instant SEPA transfers</i>	<i>Regular SEPA transfers</i>			
	Fixed	Fixed	Variable (%)	Min	Max
Santander	N.A.	-	0.40%	€ 6.00	-
BNP Paribas	€ 1.00	€ 0.00	-	-	-
Société Générale	€ 0.80	€ 0.00	-	-	-
Deutsche Bank	€ 0.60	-	1.50%	€ 10.00	-
BBVA	€ 1.25	-	0.25%	€ 1.75	-

Group Part

India

	Transfer Value	Instant Transfer (IMPS)	Regular Transfer (NEFT)
State Bank of India	Any	n.a.	n.a.
HDFC	less than ₹ 1,000	₹3.50	₹0.00
	between ₹ 1,000 and ₹ 100,000	₹5.00	
	between ₹ 100,000 and ₹ 200,000	₹15.00	
ICICI	Any	₹0.00	₹0.00

<i>(Converted to euro)</i>	Transfer Value	Instant Transfer (IMPS)	Regular Transfer (NEFT)
State Bank of India	Any	n.a.	n.a.
HDFC	less than ₹ 1,000	€ 0.04	€ 0.00
	between ₹ 1,000 and ₹ 100,000	€ 0.06	
	between ₹ 100,000 and ₹ 200,000	€ 0.18	
ICICI	Any	€ 0.00	€ 0.00

UK

	Instant Transfer (Faster Payments Service)	Regular Transfer (in €)	Regular transfer (in foreign currency)
Barclays	£0.00	£0.00	£0.00
Lloyds	£0.00	£0.00	£9.50
HSBC	£0.00	£0.00	£5.00

<i>(Converted to euro)</i>	Instant Transfer (Faster Payments Service)	Regular Transfer (in €)	Regular transfer (in foreign currency)
Barclays	€ 0.00	€ 0.00	€ 0.00
Lloyds	€ 0.00	€ 0.00	€ 10.96
HSBC	€ 0.00	€ 0.00	€ 5.77

Group Part

US

	Instant Transfer	Regular Wire Transfer
JP Morgan Chase	\$0.00	\$25.00
Bank of America	\$0.00	\$30.00
Wells Fargo	\$0.00	\$30.00
CitiBank	\$0.00	\$25.00
US Bank	\$0.00	\$30.00

<i>(Converted to euro)</i>	Instant Transfer	Regular Wire Transfer
JP Morgan Chase	€ 0.00	€ 23.71
Bank of America	€ 0.00	€ 28.45
Wells Fargo	€ 0.00	€ 28.45
CitiBank	€ 0.00	€ 23.71
US Bank	€ 0.00	€ 28.45

Legend: Domestic credit transfers fees (instant and regular) by region (original and converted amounts)

Source: Banco Itaú, Banco Bradesco, Banco do Brasil, Santander, BNP Paribas, Société Générale, Deutsche Bank, JP Morgan Chase, State Bank of India, HDFC, ICICI, Barclays, Lloyds, HSBC, Bank of America, Wells Fargo, Citi Bank and US Bank

Appendix 29

Lower Limit	€ 0.00
Higher Limit	€ 27.95
Each level interval	€ 5.59

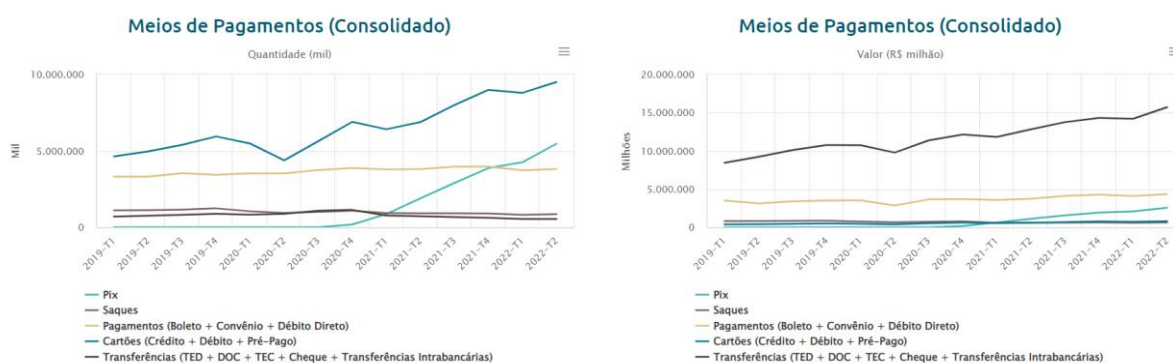
Legend: Limit calculation for credit transfers

Appendix 30

Classification	Credit Transfers		
	Lower Limit	Higher Limit	Number
Above Average	€ 0.00	€ 5.59	5
Slightly Above Average	€ 5.59	€ 11.18	4
Average	€ 11.18	€ 16.77	3
Slightly Below Average	€ 16.77	€ 22.36	2
Below Average	€ 22.36	€ 27.95	1

Legend: Limit definition for credit transfers

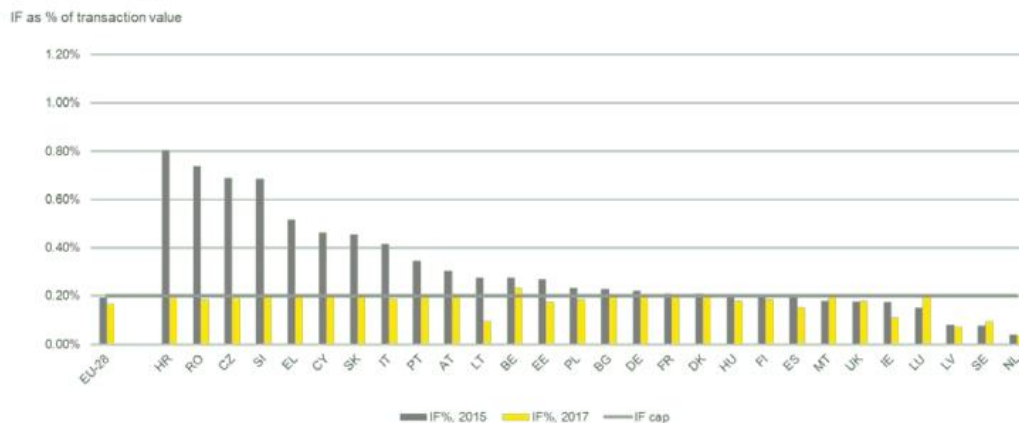
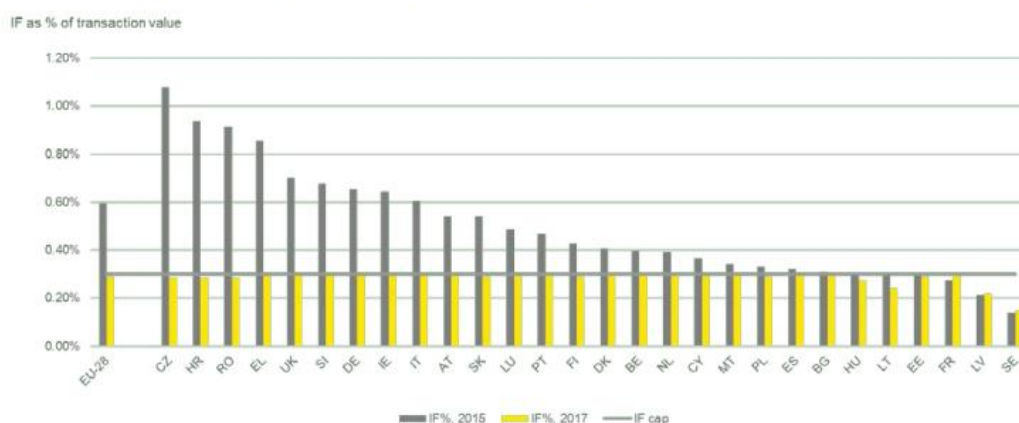
Appendix 31



Legend: Evolution of the most used payment methods in Brazil in volume and value

Source: Central Bank of Brazil. Retrieved from: <https://www.bcb.gov.br/estatisticas/spbadendos>

Appendix 32

Interchange fee for debit card transactions**Interchange fee for credit card transactions**

Note: The figures are based on data from Visa and MasterCard as well as data on interchange fees for debit card transactions from the domestic scheme in Portugal, which was the only domestic scheme providing these data. The horizontal grey line indicates the interchange fee cap for the type of card transaction. The bars in the figure represent weighted average interchange fees. Total transaction values corresponding to the interchange fees of each respondent are used as weights.

Legend: EU Interchange fee per card type, 2015 and 2017

Source: European Commission, Ernst & Young, Copenhagen Economics. Retrieved from:

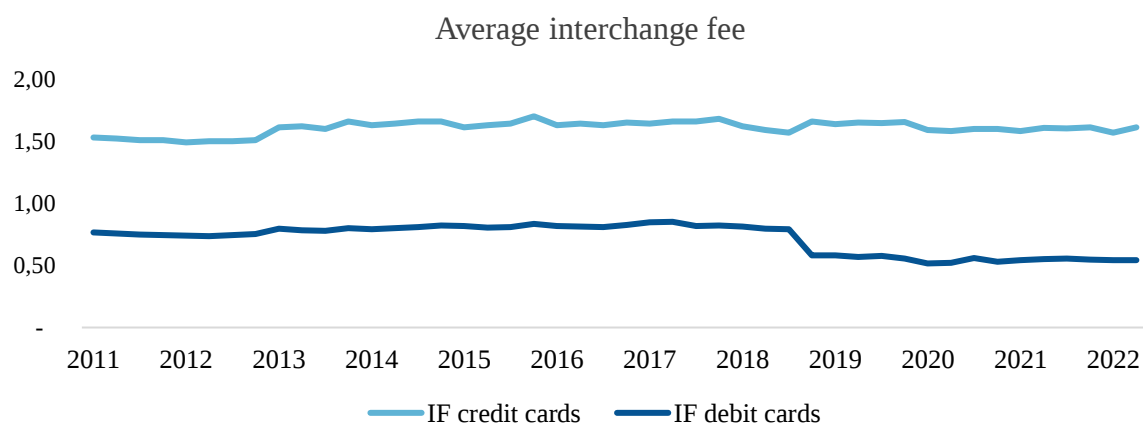
<https://op.europa.eu/en/publication-detail/-/publication/79f1072d-d6c2-11ea-adf7-01aa75ed71a1>

Appendix 33

2019	Covered transactions				
	% of total number of transactions	% of total value of transactions	Average transaction value	Average interchange fee per transaction	Interchange fee as % of average transaction value
Dual Message	62.6%	64.0%	\$40.93	\$0.22	0.54%
Single Message	63.7%	65.3%	\$38.56	\$0.24	0.61%

Legend: US average debit card interchange fee by payment card network (covered transactions) in 2019

Source: US Federal Reserve. Retrieved from: <https://www.federalreserve.gov/paymentsystems/regii-average-interchange-fee.htm>

Appendix 34

Legend: Evolution of average interchange fee by card type in Brazil

Source: Central Bank of Brazil. Retrieved from: <https://www.bcb.gov.br/estatisticas/spbadendos>

Appendix 35

	Debit Card Interchange Fee	Credit Card Interchange Fee
Lower Limit	0.00%	0.30%
Higher Limit	0.55%	1.65%
Each level interval	0.11%	0.27%

Legend: Limit calculation for interchange fee levels

Group Part

Appendix 36

Valuation	Debit Card Interchange Fee			Credit Card Interchange Fee		
	Lower Limit	Higher Limit	Number	Lower Limit	Higher Limit	Number
Above Average	0.00%	0.11%	5	0.30%	0.57%	5
Slightly Above Average	0.11%	0.22%	4	0.57%	0.84%	4
Average	0.22%	0.33%	3	0.84%	1.11%	3
Slightly Below Average	0.33%	0.44%	2	1.11%	1.38%	2
Below Average	0.44%	0.55%	1	1.38%	1.65%	1

Legend: Limit definition for interchange fee levels

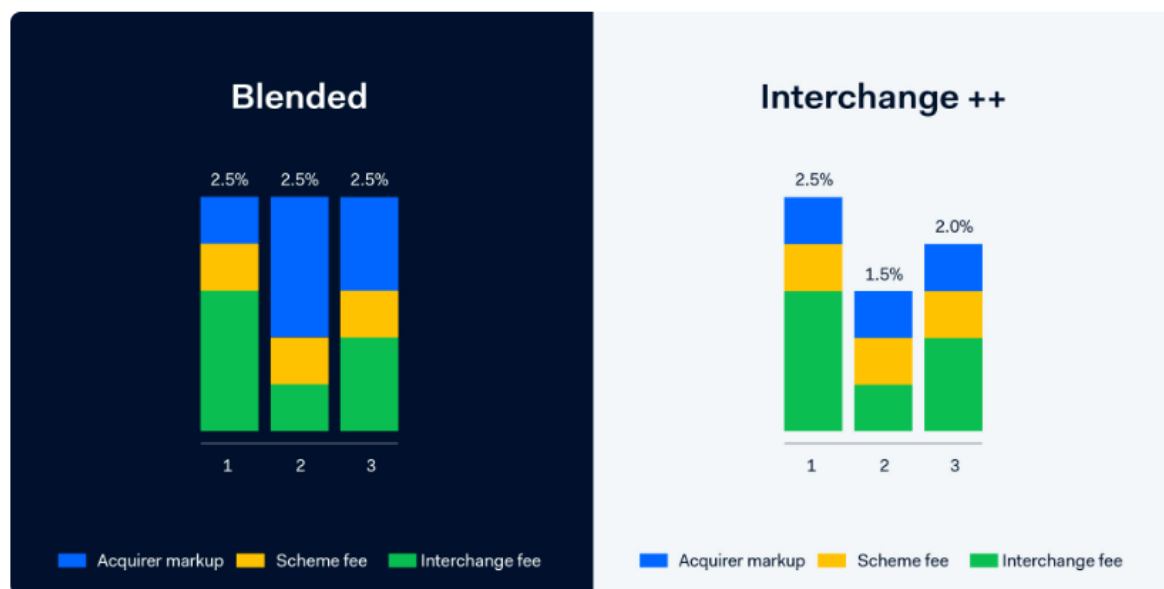
Appendix 37

	Regulation	Covered
AUS	Interchange fee: 0.2% for debit cards (or up to 10 cents) and 0.8% for credit cards. Weighted average below benchmark of 8 cents for debit cards and 0.5% for credit cards	Debit and Credit cards
BRA	Interchange fee: 0.8% for individual transactions; 0.5% for weighted average	Domestic consumer debit transactions for card present
EU	Interchange fee: 0.2% for consumer debit cards; 0.3% for consumer credit cards	Consumer debit and credit cards
IND	MSC fee: physical PoS infrastructure (including online transactions) - 0.4% for small merchants and 0.9% for others; QR-code based transactions - 0.3% for small merchants, 0.8% for others. Small merchants can only pay up to ₹200 per transaction and others ₹1,000 per transaction. In addition the Reserve Bank of India has mandated that the MSC for RuPay and UPI debit cards shall be 0%.	Debit cards
JPN	-	-
GBR	Interchange fee: 0.2% for consumer debit cards; 0.3% for consumer credit cards	Consumer debit and credit cards
USA	Interchange fee: USD 0.21 plus 0.05% of the value of the transaction, plus an additional USD 0.01 if fraud-prevention is implemented	Debit cards issued by Banks with more than USD10 billion in assets

Legend: Current regulation on interchange fees and merchant service charge in each region (breakdown of cap levels and covered payment cards)

Source: Reserve Bank of Australia, Central Bank of Brazil, European Commission, Reserve Bank of India, and US Federal Reserve

Appendix 38



Legend: Available scheme pricing options

Source: Adyen. Retrieved from: <https://www.adyen.com/blog/interchange-fees-explained>

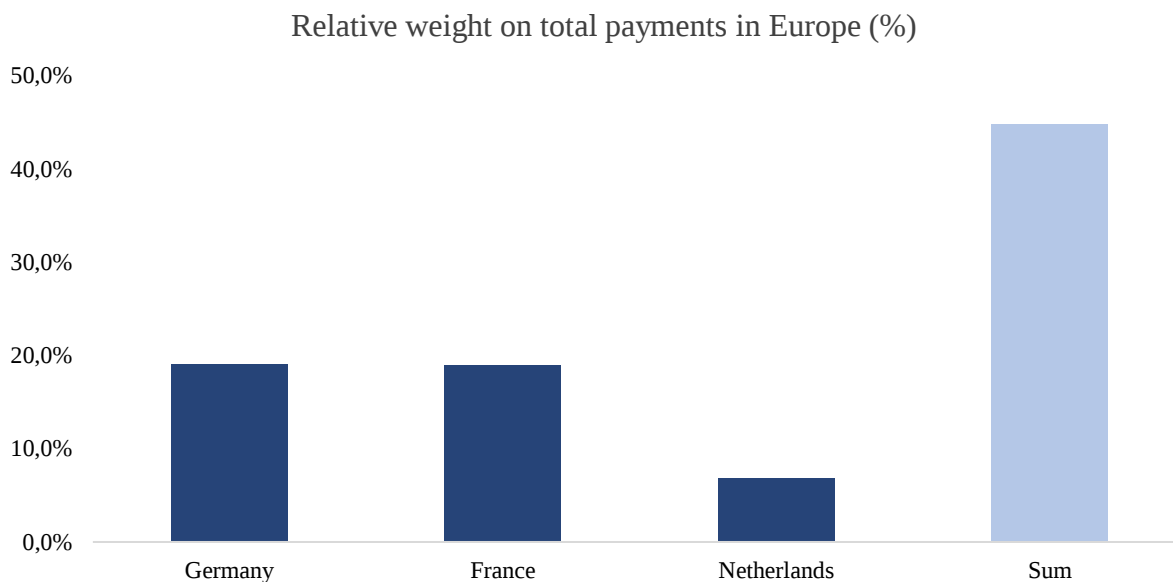
Appendix 39

Country	System	Closing time for same day transaction	Standard Opening hours closing			
			Opening	Closing	Daily Operational Period	Days
AUS	RITS	18:28 or 20:28	07:30	18:30 or 20:30	11 Hours	Business days
BRA	STR	18:30	06:30	18:30	12 Hours	Business days
EU	TARGET-2	18:00	07:00	18:00	11 Hours	Business days
IND	RTGS	-	00:30	-	24 Hours	Every day
JPN	BOJ-NET	21:00	08:30	21:00	12,5 Hours	Business days
GBR	Chaps Sterling	18:00	06:00	18:00	12 Hours	Business days
USA	Fedwire Funds Service	18:30	21:00(D-1)	18:30	21,5 Hours	Business days

Legend: Standard opening hours and standard closing hours

Source: Reserve Bank of Australia, European Central Bank, Bank of Japan, Bank of England, and US Federal Reserve

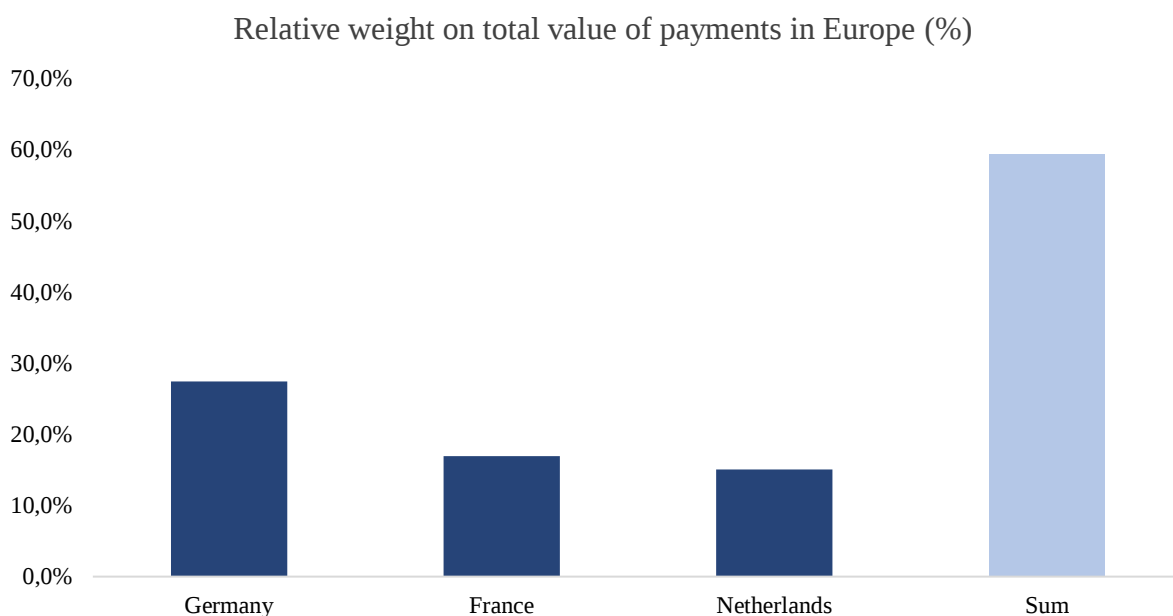
Appendix 40



Legend: The relative weight of Germany, France, and the Netherlands, and their combined total, relative to the total number of payments in the EU

Source: European Central Bank. Retrieved from <https://sdw.ecb.europa.eu/reports.do?node=100000760>

Appendix 41



Legend: The relative weight of Germany, France, and the Netherlands, and their combined total, relative to the total value of payments in the EU

Source: European Central Bank. Retrieved from <https://sdw.ecb.europa.eu/reports.do?node=100000760>

Group Part

Appendix 42

Higher limit	11.00
Lower limit	0.33
Each interval size	2.13

Legend: The quintile method applied to the number of daily settlement cycles

Appendix 43

Classification	Lower limit	Upper limit	Level Associated
Below Average	0.33	2.46	1
Slightly Below Average	2.46	4.60	2
Average	4.60	6.73	3
Slightly Above Average	6.73	8.87	4
Above Average	8.87	11.00	5

Legend: Each quintile interval had a corresponding level and classification

Appendix 44

Higher limit	77%
Lower limit	0%
Each interval size	15%

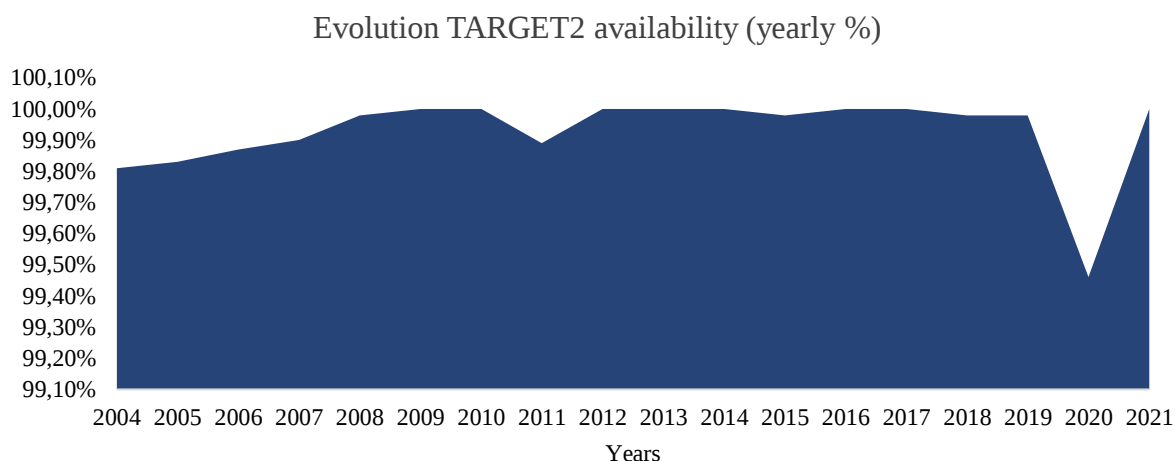
Legend: The quintile method applied to instant payments as a percentage of credit transfers

Appendix 45

Classification	Lower limit in %	Upper limit in %	Level Associated
Below Average	0	15	1
Slightly Below Average	15	31	2
Average	31	46	3
Slightly Above Average	46	62	4
Above Average	62	77	5

Legend: The quintile method applied to instant payments as a percentage of credit transfers.

Appendix 46

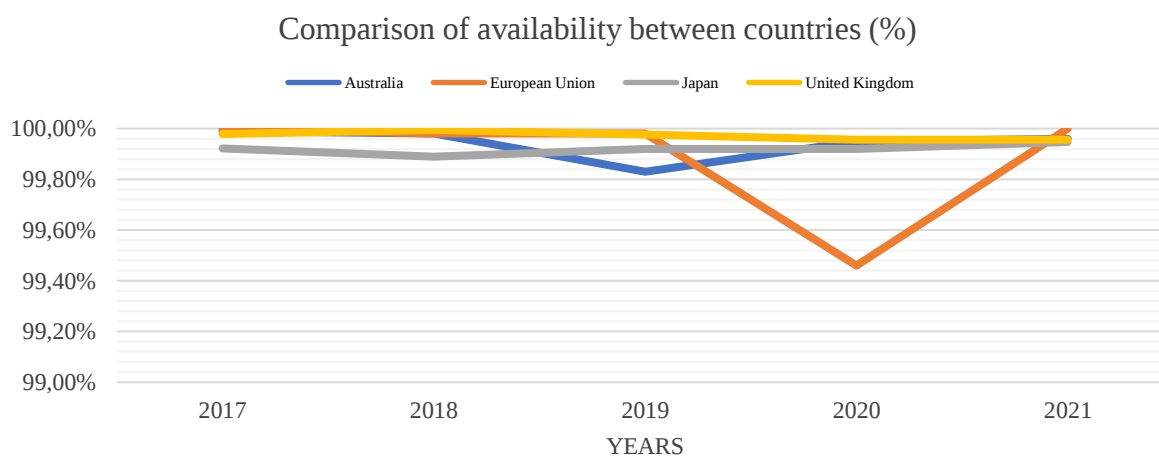


Legend: Yearly evolution of TARGET2's availability, in percentage.

Source: European Central Bank. Retrieved from:

<https://www.ecb.europa.eu/pub/pdf/targetar/ecb.targetar2021.en.pdf>

Appendix 47



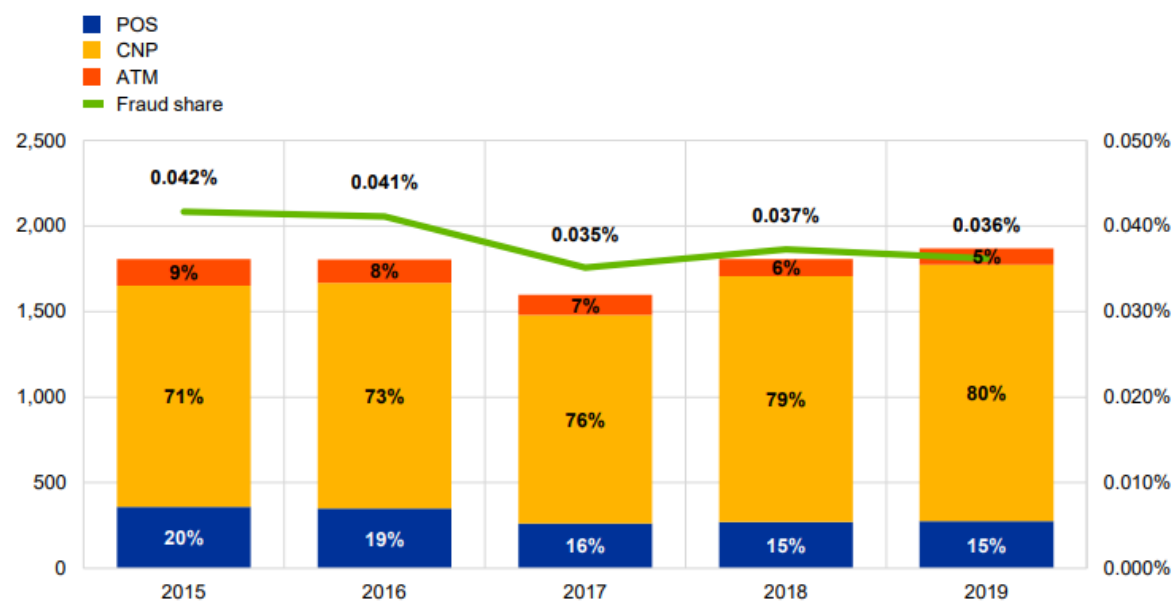
Legend: Comparison of the availability between the EU, Australia, the UK and Japan

Source: Reserve Bank of Australia, European Central Bank, Bank of Japan, Bank of England, and US Federal Reserve

Appendix 48

Total value of card fraud using cards issued within SEPA

(left-hand scale: total value of fraud (EUR millions); right-hand scale: value of fraud as a share of the value of transactions)



Source: All reporting card payment scheme operators.

Legend: Total value of card fraud using cards issued within SEPA (left-hand scale: total value of fraud in EUR millions; right-hand scale: value of fraud as a share of the value of transactions)

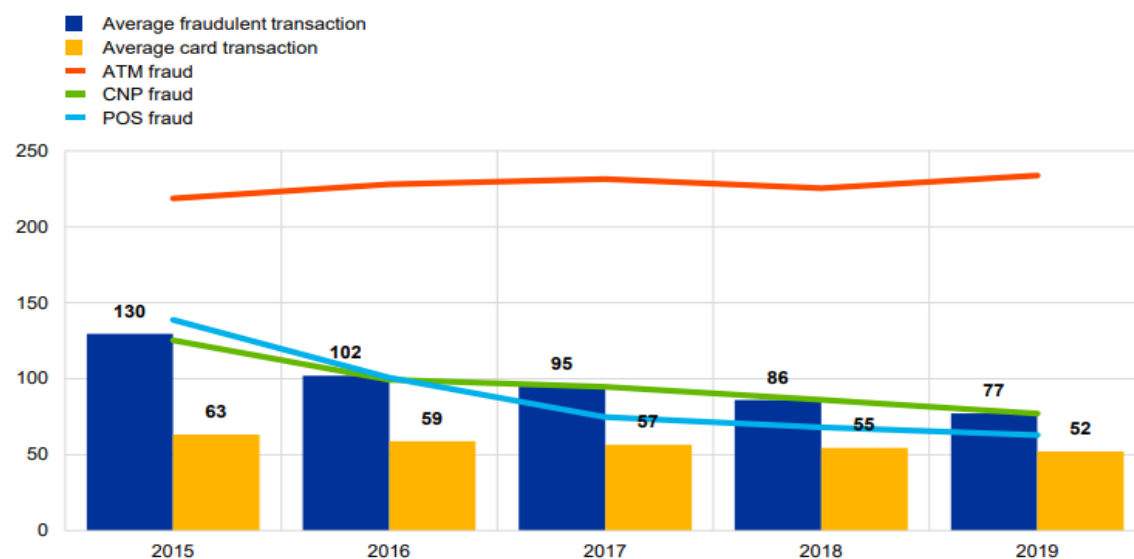
Source: European Central Bank. Retrieved from:

<https://www.ecb.europa.eu/pub/cardfraud/html/ecb.cardfraudreport202110~cac4c418e8.en.html>

Appendix 49

Average size of transactions and fraud

(left-hand scale: average value (EUR))



Source: All reporting card payment scheme operators.

Legend: Average size of transactions and fraud in the SEPA, in €

Source: European Central Bank. Retrieved from:

<https://www.ecb.europa.eu/pub/cardfraud/html/ecb.cardfraudreport202110~cac4c418e8.en.html>

Appendix 50

Higher limit	0.1025%
Lower limit	0.0360%
Each level interval	0.0133%

Legend: Limit calculation for security levels

Appendix 51

Classification	Higher Limit	Lower Limit	Number
Below Average	0.0360%	0.0493%	1
Slightly Below Average	0.0493%	0.0626%	2
Average	0.0626%	0.0759%	3
Slightly Above Average	0.0759%	0.0892%	4
Above Average	0.0892%	0.1025%	5

Legend: Limit definition for security levels

Group Part

Appendix 52

Countries	Level
AUS	4
BRA	1
EU – SEPA	5
IND	3
JPN	5
GBR	3
USA	2

Legend: Security levels for Australia, Brazil, the EU – SEPA, India, Japan, the UK and the US

Appendix 53

Higher limit	154.45
Lower limit	33.99
Each level interval	30.1167

Legend: Limit calculation for CVM contactless limits

Appendix 54

Classification	Lower Limit	Higher limit	Number
Below Average	33.99	64.10	1
Slightly Below Average	64.10	94.22	2
Average	94.22	124.34	3
Slightly Above Average	124.34	154.45	4
Above Average	No limit	No limit	5

Legend: Limit definition for CVM contactless limits

Appendix 55

	<i>Authentication Success Rate</i>			<i>Frictionless payments</i>		
Classification	Lower limit	Higher limit	Number	Lower limit	Higher limit	Number
Below Average	27%	41%	1	1%	19%	1
Slightly Below Average	41%	56%	2	19%	38%	2
Average	56%	70%	3	38%	56%	3
Slightly Above Average	70%	85%	4	56%	75%	4
Above Average	85%	99%	5	75%	93%	5

Legend: Limit calculation for authentication success rate and frictionless payments rate

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