Competitive aspects of an e-krona

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This article evaluates whether the introduction of an e-krona can be justified on grounds related to market power and insufficient competition in the payment markets. It argues that an e-krona would i) increase competition in several banking services markets by facilitating the unbundling of services, ii) significantly facilitate regulation through a combination of government ownership of a critical asset and vertical separation, and iii) help forestall a situation in which an international private digital currency also establishes itself as the de facto standard currency for domestic payments.

A key argument is that standard economic regulation is highly complex and that government ownership of key bottleneck infrastructure in combination with more light-touch regulation is a good alternative. A higher level of flexibility and control and less need for extensive regulation will likely compensate for the presumably lower efficiency of government-owned entities. Furthermore, the Riksbank would be able to provide a level playing field and equal access for different types of payment service provider. Finally, relinquishing government control over a critical asset – currency in circulation – is a process that, for political and legal reasons, would difficult to reverse.

1 Introduction

Sweden has seen an exceptionally rapid fall in the use of paper currency for payments and in the ratio of the total value of outstanding paper currency in circulation to GDP. Against this background, the Riksbank is investigating the possibility of introducing an e-krona, a central bank digital currency.

This article evaluates whether the introduction of an e-krona can be justified on grounds related to market power and insufficient competition in the payment markets, today or in a future scenario where cash is absent. More precisely, its aim is to analyse competitive aspects of central bank currency's presence, or lack thereof, as a medium of exchange available to the general public in a digital future, while considering in particular i) the rapid decline of cash use in Sweden, ii) the strong network externalities that characterise the payment market and its associated tendency towards natural monopoly, and iii) the risks for monopoly profits and inefficiencies if the payment market becomes entirely private.

The pros and cons of different policy alternatives that address the above concerns are analysed. Two alternative policy approaches stand out: firstly, adjusted and strengthened regulation and more vigorous oversight and enforcement and, secondly, the introduction of a government-owned (central bank) digital currency (CBDC or e-krona). This article draws on the experience gained from past and current economic regulation of infrastructure-based

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markets, such as the telecom and electricity markets, as well as the experience of applying competition law to platform markets, such as payment cards and operative systems. It argues that the second policy alternative, the introduction of an e-krona, should be the preferred alternative.

The paper is organised as follows. Section 2 provides an overview of the Swedish payment market from a competition perspective, with a focus on those aspects of the market that are relevant for analysing the effects of an e-krona. Section 3 deals with the economic regulation of the payment market. Section 4 analyses the competitive effects the introduction of an e-krona may have and Section 5 concludes. Three appendices discuss A) how competition law has been applied to payment card networks, B) policies that have been applied to highly concentrated industries with market power based on the control of physical infrastructure and C) policies for industries where market power is derived from network effects.

2 The (Swedish) payment market

Retail payments can be analysed and categorised in many ways. One distinction is that between payments at the point of sale and remote payments. Examples of the former are cash and card payments (at the point of sale); examples of the latter are giro payments, credit transfers and direct debits. Cards are often used for remote payments, besides being used at the point of sale. Cheques were previously common in Sweden, mainly for payments at the point of sale, while in the United States cheques are still frequently used for remote payments.

Another distinction is that between three-party systems and four-party systems. In a three-party system, the payer and the payee have accounts with the same financial service provider (for example a single bank, the PG (Postgirot) or American Express) and a payment can easily be made within the system, for example within a bank, by transferring the agreed-upon amount from one account holder to another. In a four-party system, the payer and the payee have accounts with different financial service providers (for example different banks, BG, Visa, Mastercard or Swish) and then a clearing organisation needs to process the payment instructions and send information to a settlement system where both banks have accounts. The settlement system transfers the agreed amount to the payee's bank. Via the clearing organisation, the two banks receive information that allows the payee's bank to credit the payee's account and that verifies that the amount charged to the payer's account (less fees, if applicable) has reached its destination.[12]

So far, the processing stages of individual transactions have been described from a technical perspective, focusing on the relation between the seller and the buyer of a product and the financial intermediaries that connect the two. But payment systems constitute markets of their own, where providers of payment services compete for customers and where different types of need are met by different types of payment service. This is the perspective taken by competition authorities when analysing market power.[3] In the analysis, markets will often be distinguished according to where, along the value chain, they are located. The same market participant may be a buyer of inputs and intermediate services in upstream markets – and a seller of consumer services in downstream markets.[4]

1 See Sveriges Riksbank (2013) for a more detailed explanation.

2 Yet another distinction is that between push and pull transactions. Push transactions are initiated from the payer side of the transaction; pull transactions are initiated from the payee side.

3 When competition law is applied, the analysis of market power is based on markets being delineated or 'defined' as 'relevant markets'. A relevant market is a range of products that is broad enough, in terms of geography and product characteristics, that consumers of these products are reluctant to substitute to other products if faced with a 5-10 percent price increase. See Carlsson and Bergman (2015) or other competition law textbooks.

4 'Upstream' here means earlier in the value chain. For example, a manufacturer may buy inputs and business services in upstream markets and then sell to retailers in downstream wholesale markets; the retailers sell to final consumers in markets that are even further downstream.

When analysing debit and credit cards, the EU Commission's Competition Directorate has defined an upstream 'system' (or 'network') market, where different card systems (such as Visa and Mastercard) compete with each other, and the downstream 'issuing' and 'acquiring' markets, where banks and other financial institutions compete for individuals that carry cards and merchants that accept cards, respectively.[5] In its analysis, the EU Commission found that payment cards are sufficiently different from cash, cheques and giro and direct debit services for payment card services to belong to markets separate from those for cash, cheques and so on. It remains uncommitted as to whether there are separate markets for debit and credit cards, or whether there is one market for all payment cards.

Figure 1 illustrates the principle. Banks compete for individual customers in the issuing market and for merchants in the acquiring market (the downstream market), while banks and card networks interact in the upstream system market. The EU Commission describes the situation in the following way: 'The platform run by [a card network] is not a product offered jointly to cardholders and merchants. It is a vehicle for issuers and acquirers to offer distinct services to two groups of customers.'[6] In the system market, card networks such as Visa and Mastercard offer member banks a range of services, including transaction processing, a brand (card logo) recognised by individuals and merchants, system balancing via an interchange fee (see Appendix A) and technical standards and protocols, as well as clearing services. For these services, banks pay royalties, membership fees and payment processing fees.

The notion that there exists a distinct issuing market is a simplification, since individuals often buy bundles of services linked to the transaction account, including one or two different payment cards, credit transfers and direct debit services, a savings account and perhaps mortgage, insurance and long-term saving services.[7] To varying degrees, these different financial services can also be bought on a stand-alone basis. Three-party card networks, for example, tend to contract directly with individuals, as do many providers of insurance and mortgages. Besides cooperating with banks, four-party card networks offer their services on cards co-branded with large retailers. Still, for the present purposes, as well as when the EU Commission analysed the market for payment cards, the notion of an issuing market is useful.

Similarly, merchants buy a range of services linked to card acquisition from banks, but a distinct acquisition market is a useful concept for analysing payment services. The fourth relevant market illustrated in Figure 1 is the card services market. In this market, specialised subcontractors, such as payment processors and payment switch operators, sell their services to the banks. Technically, the subcontractors may be situated between the merchants and the banks, between the banks and the card networks or between the banks and the settlement system.[8] However, this further complexity can also be ignored for present purposes, since the subcontractors act on behalf of the banks and have little ability to influence the competitive situation, except by specialising and saving costs.

Even further upstream, card networks and central banks interact in the settlement market.

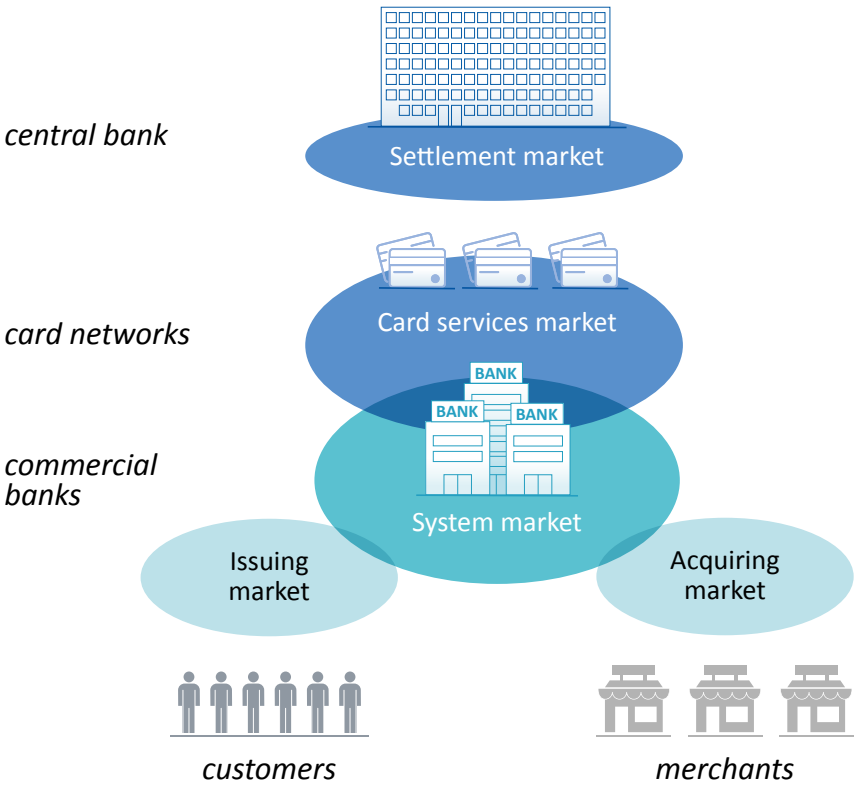
5 See, e.g., Mastercard I, COMP/34.579, at pp. 279.

6 Mastercard I, COMP 34.579, EU Commission's decision of 19 December 2007, at pp. 261.

7 These markets are sometimes referred to as cluster markets. See, e.g., the EU competition law case *EGL*, Judgment of the General Court in case T-251/12, 29 February 2016, at pp. 36. It might be more appropriate to say that banks compete in the cluster market that centers on the transaction account, than to say that they compete in the issuing market. It is widely accepted, however, that relevant markets to some extent do – and should – vary according to the question being analysed.

8 See Sveriges Riksbank (2013) for details.

Figure 1. Relevant markets in the card-payment value chain



Source: The Riksbank

The downstream system market is usually described as a two-sided market, with the two sides being individual customers and merchants, respectively. The benefits that the networks offer individuals and merchants increase with the number of merchants and individuals, respectively, that have joined the platform. However, except for these two-sided-network effects, the market positions of banks and card networks resemble those of retailers and manufacturers, respectively. Card services are, to a large extent, 'produced' upstream but mainly sold to individuals via downstream intermediaries (banks). The consumers have some freedom to choose between brands and can refrain from purchasing, but, if an individual customer wants a brand that his or her bank does not provide, the customer must turn to another bank. Typically, the platform is not offered directly by the card networks to final consumers; it is offered via banks that, in turn, are the card networks' customers.[9]

Finally, the card networks buy settlement services, often from central banks, in what could be called a settlement market. However, due to central banks often being the only providers of settlement services, this market has particular characteristics.[10][11]

Many other markets for retail payments have similar structures. Credit transfers and direct debit services are sold via banks, typically bundled with other products, to individual customers that are mainly payers, as well as to corporate customers that are both payers and payees. The transactions are processed and cleared by a systems operator, in the case of Sweden by Bankgirot (BG). Credit transfers, money orders and cheques (to the extent that

9 The fee structure used in card systems and the EU Commission's competition directorate's analysis of its anti-competitive effects are discussed in Appendix A.

10 Central banks are not the only providers of settlement services. Generally, the larger the transactions and the more systemic the associated risks, the more likely is it that settlements are made by a central bank. It will often be in the interest of commercial banks to settle in central bank systems, so as not to expose themselves to risks and so as not to have transactions settled by another commercial bank.

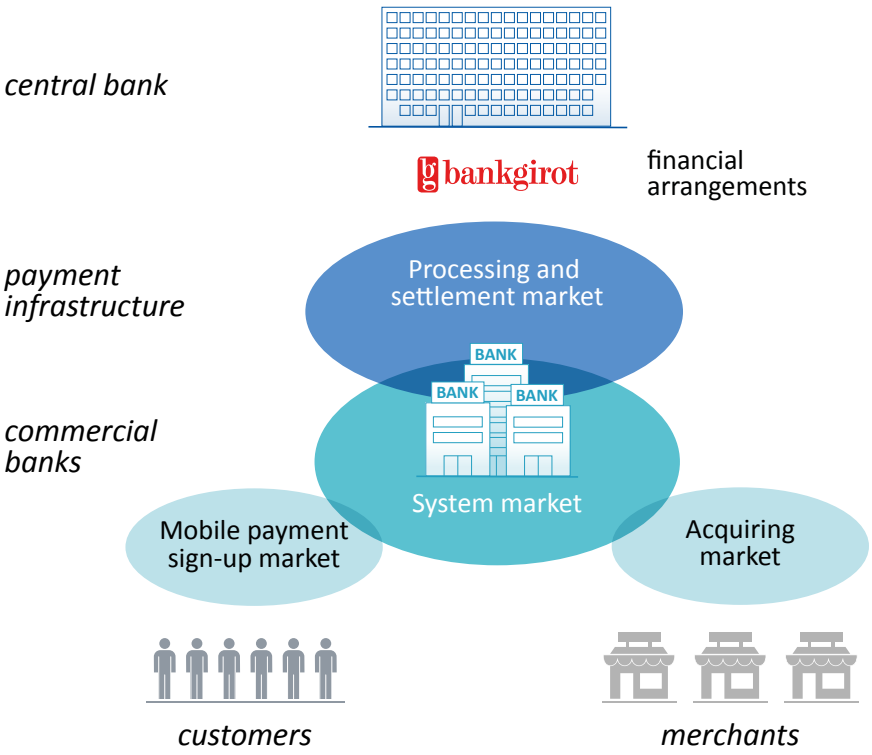
11 A similar three-layer structure is suggested in Arvidsson (2016) and repeated by the Swedish Competition Authority (2017).

they are still in use in Sweden) are processed by Dataclearingen (DCL); again these services are bundled with other products and sold to individual and corporate customers, while the banks buy services from DCL.[12]

BG is owned by seven Swedish banks, including the four largest banks, while DCL is owned by the Swedish Bankers' Association and is operated by BG. A financial institute can join DCL if it is a member of the association and if it participates directly or indirectly in RIX (see below).[13]

Innovations in the financial markets and the continuous development of IT technology have led to the introduction of new services that allow (near) instantaneous settlements. One example is the mobile payment service Swish, owned by the dominant Swedish banks. The instant payments that are made through Swish are settled directly in the system Betalningar i Realtid (BiR), owned and operated by BG. See Figure 2.[14]

Figure 2. Swish – instant mobile payments



Source: The Riksbank

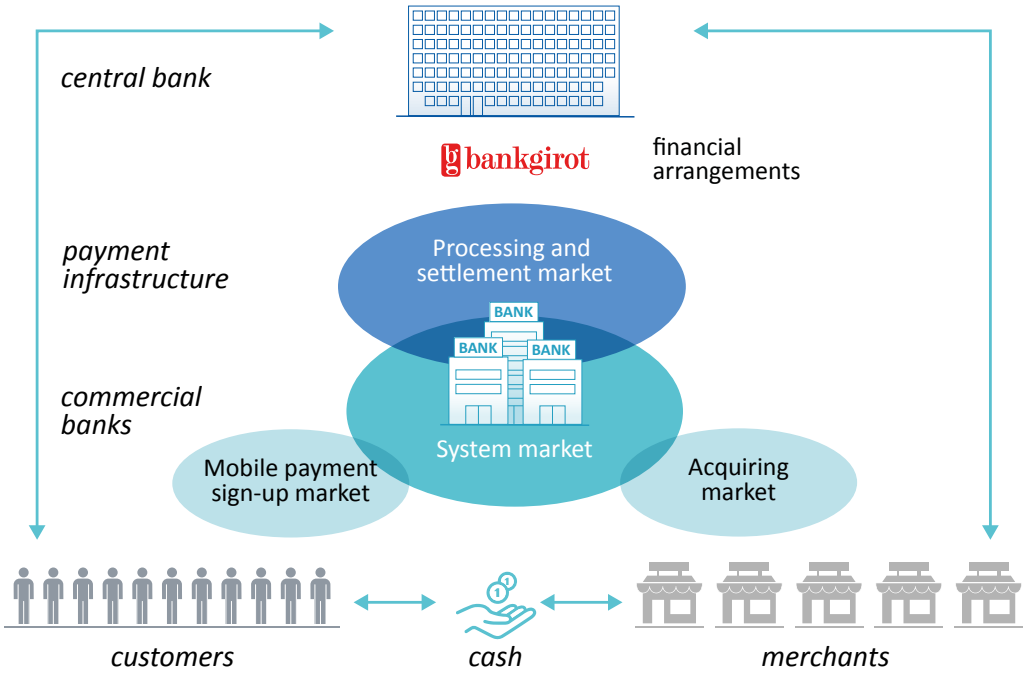
That a private company settles payments is an exception; usually large payments are settled individually by the central bank, while retail payments are aggregated and then net amounts are settled by the central bank. In Sweden, this is done by the Riksbank in its system RIX. BiR has a special arrangement with RIX that supports the atypical settlement in private bank money backed by central bank money. The European Central Bank has recently launched a platform for the settlement of instant payments, called TIPS, which can settle payments in

12 As mentioned in the discussion of the card market, technical service providers further complicate the picture. BG, for example, has outsourced most of the actual technical services to specialised providers, while retaining control over standards, customers, contracts, branding and strategic development. This vertical disintegration will be ignored in this report.
13 The banks in three Nordic countries are developing a pan-Nordic clearing organisation, P27, for cross-border payments within the Nordic region. Eventually, however, domestic transactions too will likely be processed by P27.
14 The initiative EMPSA, European Mobile Payment Systems Association, aims to link Swish to its sister organisations. Currently, Norway, Finland, Denmark, Germany, Belgium, Austria, Switzerland and Portugal are members, alongside Sweden, but the organisation expects more countries to join in the future.

euros as well as in other currencies. The Riksbank is planning to join TIPS in order to be able to settle instant payments in kronor in central bank money directly. When this happens, BiR can be devolved and the settlement stage can instead be done via the TIPS krona system.[15]

An e-krona would also require a platform for the processing of payment transactions, just as Swish or the international card networks do. However, since the accounts or digital wallets would hold central bank money, the transactions would be much less complex, with direct settlement between the payer's and the payee's accounts, as long as they both hold accounts in e-kronor.[16] This is similar to cash payments or payments within other three-party networks like American Express or the historic Postgirot. There is no need for a settlement separately from the transaction, neither for a cash payment, nor for an e-krona payment, as both involve central bank money. From the perspective of competition law and economics, and as established by the EU Commission in the Visa and Mastercard cases, cash is not considered as being on the same market as card payments. It does, however, exert a competitive pressure. This is illustrated in Figure 3.

Figure 3. Cash as a competitive constraint for Swish and card payments



Source: The Riksbank

When cash is used, notes and coins are paid to merchants as compensation for goods and services received – and debt previously owed by the central bank to the consumer is now owed by the bank to the merchant.

Cash constitutes a competitive constraint for the providers of card and Swish services, since consumers and merchants that are unhappy with the terms offered for card or Swish payments can opt to use cash instead. This option caps the banks' ability to charge high prices for their services, although, if cash is significantly more costly, is not often used, or is not seen as a close substitute, the competitive constraint may not be the one that binds. If competition is effective, it will instead be the competitive pressure from other banks that limits each individual bank's ability to set high prices.

15 Riksbank memorandum 4 June 2019 "Förstudie avseende användning av TIPS för avveckling av omedelbara betalningar' (Feasibility study concerning use of TIPS for settlement of instant payments).
16 A transaction between a holder of e-kronor and a payee that only has private bank money would need settlement through RIX Inst/TIPS.

This is in line with standard competitive analysis. A firm's competitive position is determined by rivalry within the market, by the competitive pressure from substitutes, but also by the firm's strength vis-à-vis suppliers and customers and by the threat of entry (see, e.g., Porter 1980).

Generally, competition tends to be insufficient in markets that are highly concentrated *and* where entry barriers are high. The Swedish banking market is not particularly concentrated in comparison to other industries and to the banking sector in western and northern Europe (Copenhagen Economics, 2018). However, the banking industry and, in particular, payment services are, to an unusually high degree, dependent on jointly owned assets, while network effects are important for payment markets. Entry barriers are so high that often the only realistic alternative for a new entrant is to seek access to existing systems, such as BG and DCL, while network effects make it essential to be able to process payments, directly or indirectly, to and from accounts in other banks.

The international market for payment cards *is* highly concentrated and characterised by strong network effects. In contrast, some markets for transaction processing services may be highly concentrated, but entry barriers are lower and network effects less important. In Sweden, as well as internationally, retailers have expressed concerns about high fees for payments with cards and competition authorities have taken actions against fee levels, as discussed in the appendix. Furthermore, entrant financial service providers have expressed concerns over charges for access to the jointly owned assets, such as BG.

The following section discusses pro-competitive regulation that has been introduced; regulation that centres on access for payments to and from accounts in other banks.

3 Pro-competitive regulation in the payment markets

The financial markets, including the market for payment services, is already extensively regulated, with some of the rules aiming specifically to promote competition. Other rules have other primary objectives but may still be relevant for the level of competition. This section will only briefly touch on some of the rules that have a clear relevance for the competitive situation in the payment markets.

The payment service directives (PSD and PSD2[17]) aim to harmonise rules for consumer protection and rules that regulate firms' right to provide payment services in the market. The PSD's purpose in regard to the payments industry was to increase pan-European competition with participation also from non-banks, and to provide for a level playing field by harmonising consumer protection and the rights and obligations for payment providers and users. In this context, it is also relevant to mention the Single Euro Payments Area (SEPA), a self-regulatory initiative by the European banking sector that aims to harmonise the infrastructure and the technical standards (Sveriges Riksbank, 2013).

PSD2 broadened the scope of the PSD1 regulation to include more types of services and market participants including, in particular, third-party providers that offer instant payment services for e-commerce customers, so called payment initiation services. These services do not rely on payment cards but instead use the payer's online banking module; one example of such a provider is Trustly.[18] Such services, which had begun to develop prior to the introduction of PSD2, now obtained stronger legal protection, as, under the new directive, banks are also required to provide access to their payment accounts for these service providers. Access should be provided under objective, non-discriminatory and proportional terms, in a way that does not block or hinder access to payment accounts. Under PSD2, a bank may not refuse to open accounts for a third-party provider. If it does, it has to have

17 Payment services (PSD 1) - Directive 2007/64/EC and Payment services (PSD 2) - Directive (EU) 2015/2366

18 https://ec.europa.eu/commission/presscorner/detail/en/MEMO_15_5793, accessed on 12 January 2020.

fair and reasonable causes and it has to notify the financial supervisor and explain those reasons.[19]

PSD2 also strengthens the position of consumers by requiring banks to release transaction data, at the request of the individual that made those transactions, to authorised or registered third parties.[20] For example, this would allow a consumer to reveal the complete financial history of his or her payment account to a stand-alone mortgage company or to a firm specialised in consumer credits. The UK implementation of PSD2 goes further, in that it requires standardisation of the format in which large banks release transaction data.[21] For example, the UK regulation requires banks to offer open APIs (applications programming interfaces), in practice through their enrolling in the Open Banking initiative.

While SEPA harmonises standards at the wholesale level, harmonisation at the level of end consumers is also needed for pan-European services to develop. Consequently, the EU Commission has initiated work to develop common standards for consumer interfaces. The payment services directives are likely to influence the markets for payments through several mechanisms. The EU Commission aims to facilitate cross-border payments so that, eventually, previously separate national payment markets will merge with the market for cross-border payments into a single EU-wide market. Also, promoting non-banks' participation will serve to increase competition for incumbents through new entry and by opening the market for competition between services based on different technical solutions (for example, payment cards versus payment initiation services). Finally, the regulation promotes vertical specialisation, potentially resulting in new financial services markets being established.

The tradition of setting up jointly owned systems (BG, DCL, the Swedish ATM system Bankomat, as well as the international card systems) makes payment markets more amenable to competition law than markets with individually owned assets.[22] A jointly owned system will often be considered as an agreement between firms and then competition law is applicable even if the system is not dominant. Following this logic, and also because it considered competition to be weak in the market for cross-border card payments, the EU Commission initiated a series of cases against the card networks. The cases are summarised in Appendix A. By applying competition law, the EU Commission achieved a resolution that has much in common with how an economic regulation of the sector may look. It capped prices in the upstream market (the interchange fee; see the discussion in the appendix) in the expectation that this would result in lower prices in the downstream acquiring market.

In fact, the subsequent 2015 Interchange Fee Directive follows the same logic as the competition law cases but goes a little further. It covers all four-party systems, not just Visa and Mastercard, and it covers domestic transactions, not only cross-border payments.[23] Four-party systems' MIFs are capped, but not those of three-party systems, such as American Express. However, while four-party systems are allowed to impose a ban on surcharges on merchants, three-party systems are not. This means that merchants are now in a better position to fight back if they believe merchant fees are unreasonably high. Similarly to what was achieved through the application of competition law, the card networks are required to specify fees, which makes it easier for merchants to unbundle the package of services the networks offer and to buy some services from third-party providers.

The Interchange Fee Directive is likely to have resulted in better competition and lower merchant fees, at least for large retail chains. It has established the principle of unbundling,

19 See Financial infrastructure 2016, Sveriges Riksbank, pp. 13–16; Payment in Sweden 2019, Sveriges Riksbank, pp. 7–8.
20 Depending on what service the third-party provider offers, it will need to be authorised or only registered.
21 https://www.wired.co.uk/article/open-banking-cma-psd2-explained
22 The international card networks were restructured in 2006-2007, from cooperative arrangements to regular listed corporations, possibly as a response to regulatory challenges from competition authorities, as discussed in Appendix A.
23 Since the member states are obliged to apply domestic competition law in conformity with how the EU Commission applies EU's competition rules, the payment card cases indirectly also had implications for domestic transactions.

with potential efficiencies due to specialisation and scale economies. The EU Commission is expected to publish a first evaluation in the summer of 2020.

Another set of rules comes with the Cross-Border Regulation, under which cross-border payments should be no more costly for consumers than domestic payments. The regulation initially applied only to the Euro zone and – following a voluntary Swedish initiative – to the krona. Following the 2019 revision, the regulation now applies to all EU currencies. It is noteworthy that the Cross-Border Regulation applies to consumer prices – the issuing market[24] in the terminology of Figure 1 – while the Interchange Fee Directive applies to prices at the wholesale level. The latter is more congruent with the perceived regulatory model.

Lastly, the Transaction Account Directive and the Settlement Finality Directive can be mentioned. Under the former, banks have to open accounts for EU citizens from other member states at fair prices, making it easier for consumers to unbundle financial services and, in that way, expose their domestic bank to competition from banks in other member states. The latter directive aims to create stable and uniform rules for settlements, in order to reduce systemic risks, but, in doing so, it requires non-bank payment-service providers to settle payments via banks, hence making entry more difficult (Górka 2016).

Overall, recent EU regulation of the payment markets follows the same logic as telecom regulation. Banks are increasingly required to provide access at fair prices in upstream markets to their downstream rivals. The presumption is that this will increase downstream competition due to new entry, due to previously national markets becoming more integrated, as well as due to unbundling and increased horizontal and vertical specialisation. This process is ongoing and it is still too early to say whether and to what extent it will be successful. However, the experience from telecom suggests that regulation must continuously be developed to accommodate market changes driven by technical innovations – and that an extensive array of regulatory measures is needed for complex and evolving markets.

4 Pro-competitive effects of an e-krona

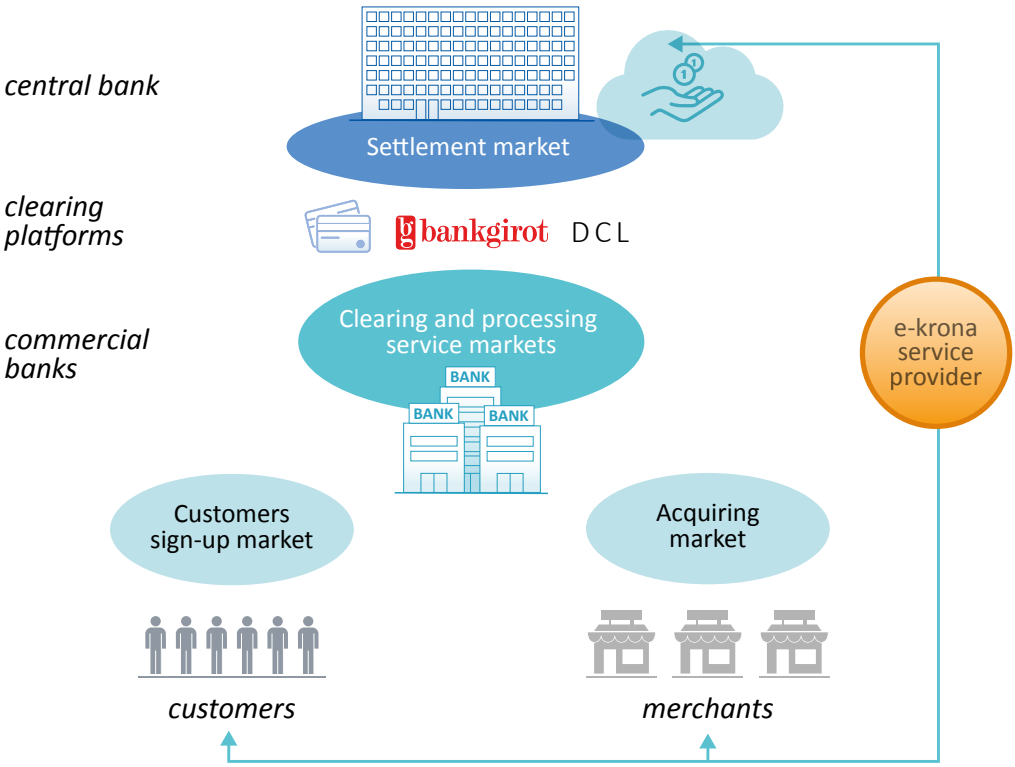
In the following, it will be assumed that the Riksbank will contract directly with individuals and merchants only rarely or not at all. As the e-krona will be digital, technical assistance will have to be provided by financial specialists such as banks. In terms of Figure 4, the Riksbank will continue to be the main seller in the settlement market and it will be active in a market where it provides wholesale access to e-krona accounts through a technical interface (API) that can be used by banks and other financial service providers. This market will be upstream, relative to the downstream market where e-krona accounts and linked services are provided to final consumers by financial service providers. That downstream market may develop into a relevant market of its own, or e-krona accounts and services may remain a product that is sold as part of a more general banking services bundle.

An extensive discussion of the technical differences between a value-based and an accounts-based e-krona (or CBDC) is outside of the scope of this report. A digital currency requires a ledger, distributed (as for Bitcoin) or not. The ledger can be linked to identified persons and the e-krona will then be based on accounts; it can be linked to potentially anonymous numbers or codes that can be transferred between individuals (like a pre-paid card for public transport or mobile telephony) and this can be interpreted as a value-based system. In the following, however, I will assume that an accounts-based and a value-based

24 Relevant markets are typically defined to be relatively narrow. It is possible that the EU Commission would find that the consumer market for cross-border payments with cards is a relevant market separate from that of the issuing market. This depends, among other things, on whether consumers would take the cost of cross-border payments into account when they choose payment cards and banks. Also, as discussed in the previous section, consumers may be active in a market for bundles of financial services.

e-krona system will be presented to the consumer in such a way that they would appear to be similar; in fact as accounts.[25] For that reason, in the following, I will be discussing accounts.

Figure 4. e-krona allows entrant payment-service providers



Source: The Riksbank

Under such a scenario, the launch of an e-krona system will shift part of the activities currently undertaken by BG (via BiR) or by DCL in combination with RIX to the e-krona system. Merchants and consumers will still be dependent on banks and other financial service providers for processing payment transactions. However, if the Riksbank offers an open API at the wholesale level, new payment transaction providers can enter and offer their services without having to depend on the incumbent banks and the existing payment infrastructure. That is, the introduction of an e-krona will not allow consumers and merchants to bypass financial service providers completely, as they (perhaps) can do with cash, but it could make it easier for new service providers to enter.

Seen from the perspective of an entrant financial service provider that wants to sell payment services, the extent to which an e-krona would facilitate entry also depends on whether the new firms would be dependent on accessing individual customers' and merchants' accounts with the old bank. If they are, the e-krona will likely not make entry much easier. Third-party providers of payment services already have access to bank accounts under the PSD2 regulation and consumers may not have strong incentives to open e-krona accounts. This is the chicken-and-egg problem that characterised two-sided markets. Consumers have little incentive to open e-krona accounts before there are useful services linked to such accounts; payment services providers have little incentive to develop services before there is a substantial customer base.

25 The underlying technologies may differ but will, presumably, be presented to the consumer in identical manners.

However, if a large fraction of the population has e-krona accounts and if these accounts can be accessed through an interface (API) provided by the Riksbank according to an open standard, then entry by rival payment providers *would* be facilitated.[26] It would then be possible to enter the payment market without being dependent on access to existing bank accounts via BG, DCL or the international card systems and without the entrant having to build its own customer base, customer by customer, as the card systems had to do when they were launched (Evans and Schmalensee, 2005, 2015). Also, new entrants would not be dependent on buying services from BG and other entities jointly owned by the incumbent banks. The availability of an attractive alternative for payments would increase competition throughout the relevant payment services markets. The direct effect may be most significant in the market for clearing and processing services, where competition is limited, but indirectly such a development may stimulate the unbundling of consumers' banking services more generally.

An e-krona in combination with the wide adoption of e-krona accounts would make it possible for an entrant payment service provider to bypass the clearing and processing services markets (at the same time, it obviates the need to settle the transactions, in turn reducing transaction complexity and hence, possibly, transaction costs). This is analogous to the scenario foreseen in the Microsoft case discussed in Appendix C, where the combination of Netscape and Java threatened (from the point of view of Microsoft) to develop into a substitute for Windows.

Even if the e-krona would not be widely used, its mere existence would introduce potential competition for the established payment systems. Retail chains and other 'merchants' would perhaps be able to obtain better deals, if they could more credibly threaten to launch their own payment system or to sponsor a new entrant. The prospect of entry may keep fees lower and induce the payment service providers to improve service quality.

In addition, the launch of an (accounts-based) e-krona would represent a way for the government to maintain control over an asset that is or could become key for controlling the payment system. This is in parallel to the government retaining control over the electricity market, by owning the transmission network, and over the rail market, by owning the tracks, even though the markets for power generation and train services, respectively, have been deregulated.

Another analogy is the telephone numbers system. A telecom network operator controls access to its own subscribers and enjoys a gatekeeper position. Even if the market becomes quite fragmented, each operator is the only one that can connect a call to its own customers, since it controls the terminating segment. Absent regulation, it would be able to extract monopoly profits by setting a high termination fee. If the originating network operator cannot set different prices for different terminating networks, the incentive to set a high termination fee actually becomes stronger the more fragmented the market is. The EU and its member states have an extensive bureaucracy that regulates access prices in the telecom market. Initially, fees were regulated for both the originating and the terminating segments, but, for the last few years, only the terminating segment has been regulated.

Government ownership and government regulation are substitutes, when it comes to controlling market power for key infrastructural assets. A vertically separated state-owned firm may not be as efficient as a private firm, but it has less incentive to favour certain customers over others and it is easier to regulate than a vertically integrated private company.

The history of market dominance and leapfrogging in the tech markets offers several lessons. When network effects are strong, dominance will arise and the dominant firm

26 The Berlin Group's API standard, NextGenPSD2 Access, is an example of an open standard. See further https://www.berlin-group.org/governance-and-structure

will do its best to erect entry barriers, in order to preserve its position as long as possible. Eventually, a new technology will emerge, surpassing and replacing an older technology and the entrenched dominance. However, even if such a challenge will eventually be successful, the process is protracted and meanwhile prices will tend to be too high, resulting in static efficiency losses. Given the increased globalisation of markets, a private solution that emerges as a substitute for cash is not likely to be Swedish; more likely it will arise out of the US market or possibly out of one of the major European markets.

To summarise, the introduction of an e-krona along the lines set out in this report would likely intensify competition on a number of banking markets, in particular relevant markets for payment services, but possibly more generally for banking services. Through a relatively limited government presence in the market, it would offer a structural mechanism for more intense competition. Generally, structural resolutions to impediments to competition are to be preferred over regulatory resolutions, as the former are more robust and more conducive to innovation and technical change, while, at the same time, they reduce the need for complex and costly regulation.

5 Conclusions

This article set out to analyse the competitive impact of introducing a central bank digital currency in Sweden, where cash use is falling rapidly. A maintained assumption is that strong network externalities characterise the payment markets and that, consequently, these markets are at risk of developing into monopolies or tight oligopolies if left unregulated.

The article provides an overview of policy alternatives that have been used in markets that share some of the payment market's characteristics and discusses existing pro-competitive regulation that applies to the payment markets. Against this background, it tries to predict the consequences for competition in the payment market of an e-krona.

The analysis suggests that there are at least five possible efficiency reasons for introducing an e-krona (and promoting wide adoption of e-krona accounts):

1. To increase competition for i) banks in the transactions account market by facilitating the unbundling of banking services, ii) providers of clearing and processing services, such as BG, Visa and Mastercard and iii) existing payment services, such as Swish, that depend on the existing clearing and processing service providers.
2. To combine government ownership of a critical asset – control over an e-krona system, including control of the ledger and the API necessary for financial intermediaries to access the e-krona accounts – and vertical separation, as a substitute for a bureaucratic regulatory system that sets prices for wholesale access to the payment system.
3. To avoid a situation where an international private digital currency also establishes itself as the de facto standard currency for domestic payments, with associated market power concerns.
4. To provide the foundations for a simpler routing of payment transactions, one that potentially dispenses with the need for separate clearing and settlement stages and that consequently may offer significant cost savings.
5. To provide a routing of payment transactions that does not depend on clearing and settlement systems based outside Sweden. This would improve the resilience and sovereignty of the Swedish payment system.

The validity of the first argument depends on the level of competition in the retail banking market and in the affected payment systems markets. The number of retail banks in Sweden is relatively large and, compared to many other services markets, the market concentration does not stand out as markedly concentrated. However, consumers' reluctance to switch

between banks weakens the effective competitive pressure and the Swedish Competition Authority has often held up retail banking as a market with relatively weak competition.

In the clearing and processing markets, BG's pivotal position and the fact that it is jointly owned by the dominant incumbents suggest that the introduction of another way to route payment transactions would be helpful, especially for new entrants. There is a history of complaints against the jointly owned systems, suggesting that incumbent banks try to prevent or at least limit new entry into the banking and payment markets by setting high access prices and otherwise impeding entrants' access to the systems. While the international card networks provide some competition and offer alternative routes for payment transactions, Visa and Mastercard are not direct competitors to BG and offer only imperfect substitutes.

However, the capability of an e-krona to intensify competition should be seen against existing regulation that aims to promote competition, such as the PSD2 directive that requires banks to provide access to accounts for payment initiation services. It should also be seen in the light of the chicken-and-egg problem this market shares with other two-sided markets: that consumers are likely to start using e-krona on a large scale only when useful payment services linked to such accounts have emerged – and payment service providers have weak incentives to develop such services before there are customers.

From a regulatory perspective, government ownership of a critical asset, especially in combination with a strategy of restricting the government entity to only those services that are best served by a monopoly – that is, a strategy of vertical separation – is a parsimonious alternative to an extensive regulatory machinery. This has been the model deployed for electricity markets, where governments often retain ownership of the (high-voltage) transmission network. The telecom market is an example of a complex system that has been successfully regulated without government ownership as a cornerstone of the regulatory regime. By and large, the interests of the owners of the networks and that of their access-seeking rivals have been balanced. However, it is an extensive regulation that is costly to maintain. Expressed differently, government ownership of key assets – and regulation – are, to some extent, regulatory substitutes. When the government controls infrastructural bottlenecks, regulation can be less comprehensive.

The third argument in the above list is concerned with the possibility that a private company will be able to obtain at least a temporary dominance over an international digital currency. Even if that company and its technology will eventually be superseded and even if that company is regulated, its ability to exercise market power will not be completely curtailed and it will do its best to deter rivals from challenging its position. This argument stands in addition to the possible benefits that may arise from a better ability to pursue monetary policy if the government controls the monetary base.

An evaluation of the validity of the final two arguments is outside of the scope of this article. They appear, however, plausible at first glance. Finally, it is worth repeating that a maintained assumption has been that the e-krona accounts ledger will be controlled by the Riksbank and made available to banks and other financial service providers (but not to end users) through an open API. Other solutions are possible. For example, the e-krona accounts ledgers could be maintained by commercial banks and then the competitive effects would be different; in this particular case, the pro-competitive effects of introducing an e-krona would be less pronounced.

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Appendix A. Competition issues for debit and credit card networks

A payment card system will need to attract both card holders (individuals) and merchants. A larger number of card holders will make a card more attractive for merchants; wide acceptance among merchants will make a card more attractive for potential card holders. This is known as a two-sided network effect and markets characterised by this phenomenon are often called platform markets.[27]

Card holders typically pay a monthly fee for their card, possibly as part of a larger bundle of bank services. Merchants pay a fraction of the transaction value and/or a per-transaction fee. In principle, each additional card holder adds a marginal cost to the system-wide cost of operating the card scheme, as does each additional card transaction. However, much of the costs will be fixed system costs that need to be allocated, either to the card holders or to the merchants, and this can be done in many ways, depending on the objectives. Typically, this entails adding a margin over and above the respective marginal costs.

It may be that card holders are more price sensitive (have a more elastic demand) than merchants, so that it is socially optimal to have a lower price-cost margin for card holder services than for acquiring services. If card holder demand is sufficiently elastic, the social value of the payment card system may, in principle, be maximised by setting a price below marginal cost, possibly at zero or even below zero. In fact, the card networks have argued that strong two-sided network effects and large differences in price elasticities between the two sides have made it optimal to subsidise cardholders and to surcharge merchants. Historically, credit cards have often been provided free of charge and often also promoted with loyalty schemes and cash paybacks for individuals that use cards heavily.

The card networks can balance the allocation of common costs between the two sides, the card holder side and the merchant side, by setting the fee paid by the acquiring banks to the (card) issuing banks, a fee known as the MIF (multilateral interchange fee). For example, if the acquiring bank has to pay 0.5 per cent of the transaction value to the issuing bank (the bank that has, as one of its customers, the card holder that makes the purchase), the marginal cost of the acquiring bank rises correspondingly and the latter bank will be incentivised to set the merchant fee 0.5 per cent points higher than it otherwise would. Similarly, the issuing bank will have incentives to lower its fee; for example, by introducing a loyalty scheme that awards 'points' or gives cash-backs in proportion to purchases.

Merchants have historically complained that merchant fees have been too high and that the banks (or the card networks) have exploited the fact that they are more or less compelled to accept card payments, so as not to lose customers, and also that fees are much higher than the benefits the merchants derive for receiving electronic payments rather than cash payments. The card networks have made the choice situation for merchants more challenging by adding rules that make it even more difficult for merchants not to agree to pay high merchant fees. One example is the honour-all-cards rule, which stipulated that a merchant that accepted (relatively low-cost) debit card payments from a particular brand (Visa, say) also had to accept (much more expensive) credit card payments. Another example is the no-discrimination rule, under which merchants are allowed neither to surcharge customers that use credit cards to compensate for the merchants' card fees nor to discount prices for customers paying with cash. Such price differentiation could otherwise be used to steer card holders toward the payment instrument that the merchant sees as the most cost effective.

While subsidising card holders and surcharging merchants may be a socially efficient way of increasing network effects, there is also another rationale for shifting revenues from

27 See further in Appendix C.

the acquisition market to the issuing market. If revenues are shifted from a more to a less competitive market, the banks' overall profits increase.[28] It seems likely that the acquisition market, with merchants as the buyers, is more competitive than the issuing market, where the customers are individuals.

In relatively small countries such as Sweden, banks have been able to negotiate the interchange fees bilaterally. Competition law views bilateral agreements as a normal and unavoidable consequence of doing business; hence the presumption will be that an agreement between a seller (for example, an issuing bank) and a buyer (for example, an acquiring bank) will be legitimate. However, when it comes to multilateral agreements, competition law takes a more restrictive view. By its nature, an MIF will be an agreement between multiple sellers and multiple buyers and hence the presumption will be that it is an illegitimate agreement, albeit an agreement that may, depending on the circumstances, ultimately be allowed. It will be tolerated if its positive effects are sufficiently strong and if its negative effects are small and no larger than they have to be.[29]

In large jurisdictions, such as the United States, and for cross-border card transactions, the number of banks is so large that it becomes impractical or even impossible to establish a system based on bilateral agreements. Consequently, MIFs have, in principle, been tolerated by competition authorities such as the EU Commission and its competition directorate. However, since the 1990s, the EU Commission has investigated the card networks' pricing and rule setting. While MIFs may be indispensable and while fees may be set to balance the two sides of the market and to optimise network effects, they may potentially also be used for anti-competitive reasons, as discussed above.

Initially, the EU commission focused on the rules that the merchants had to accept, including the honour-all-cards rule, rather than the MIF itself. In 1999, it informed Mastercard's predecessor Europay[30] that it had concerns that the specifics of some of these rules violated the competition rules. In 2002, it accepted Mastercard's revised set of rules but opened an investigation into the level of its (and Visa's) MIF. In 2007 it found that the MIF violated competition law, a finding confirmed by the Court of Justice in September 2014. In 2009, Mastercard reduced its MIFs to 0.2 per cent and 0.3 per cent for debit and credit card transactions, respectively, in order to comply with the Commission's findings. These caps were subsequently also applied to Visa, in decisions by the EU Commission in 2010 and 2014 and then, in 2015, further confirmed and extended to all card systems when the EU Parliament in April of 2015 adopted the Interchange Fee Regulation, IFR.[31]

The intervention by the EU Commission and the subsequent introduction of sector-specific EU legislation have had the effect that wholesale prices paid by acquiring banks for necessary services have been price regulated. The analogy to consumer prices, the merchant fees paid by retailers to the acquiring banks, have not been regulated. The new rules are intended to reduce upstream prices, after which downstream competition, in the acquisition market, is supposed to result in lower merchant fees. This is in line with the general principles for economic regulation that, since in the early 1990s, have become the established norm. Direct regulation of consumer prices, as in the Cross-border Regulation, is a contradiction of these principles.

To summarise, the international four-party card networks were organised so that they could effectively coordinate the pricing of the participating banks through the level of the MIF. This made it possible for the networks to optimise network effects, potentially increasing the social value of the payment cards – but it also made it possible to increase the

28 Notice that, under this hypothesis, the market elasticity of the issuing market is higher than that of the acquiring market, while each bank faces a (firm) elasticity that is higher in the acquisition market than in the issuing market.

29 This is a simplification of how agreements are analysed under competition law; for more extensive treatments, see standard textbooks.

30 In 2002, (the European) Interpay merged with (the American) Mastercard.

31 IFR, in addition, mandated other changes, intended to increase competition in processing and acquisition. See also Section 3 in the main text.

participating banks' profit at the customers' expense. Revenues could be shifted from the more competitive acquisition market to the less competitive issuing market, increasing the banks' overall profit.

Competition law is applicable, since an MIF by its nature is an agreement concerning prices between several firms. The MIF is the price banks charge one another for issuing services and its level is a main determinant of the fee that the banks charge merchants in the acquiring market. Competition law was used to cap the MIF but subsequently a sector-specific regulation has been adopted. The new regulation puts similar but stronger restrictions on the freedom of the banks and the card networks to set prices and other market conditions.

As a consequence of the new legislation, the pricing of payment card services has been rebalanced, so that (large) merchants pay less. Competition also appears to have become more intense in other respects, although, for heavy card users, the rebalancing of prices has, of course, resulted in less generous rewards from the loyalty programmes.

Competition law was effective since MIFs are agreements that involve multiple banks and affect banks horizontally; then competition law can be used to regulate or at least cap the price level. In contrast, bilateral interchange fees are much more difficult to challenge under competition law. The same goes for transaction and processing fees, which, by nature, are vertical payments from merchants via acquiring banks to the payment card networks. In 2006 and 2007, the corporate structures of Mastercard and Visa, respectively, were transformed from being jointly owned and controlled by a large number of banks, into normal listed corporations.[32]

32 Visa Europe, a membership association and cooperative controlled by several thousand European banks, was acquired by Visa in 2016.

Appendix B. Policy options for market power arising from physical infrastructure

Different policy options have been used at different times and in different markets to manage market failure due to market power. Often the root cause of the problem has been the existence of a physical infrastructure that is indispensable for firms that want to be active in the market and that is so costly that duplication is not a feasible option. This type of problem has long existed and special regulatory institutions have had time to develop. Examples include the transmission and distribution system for electric power, rail tracks and critical parts of the fixed-line telecom network. In some industries, technological developments have resulted in changes regarding which components of the physical network are natural monopolies and which components are not. Much of the telecom network was previously a natural monopoly; today it is mainly the wires or fibres that connect individual subscribers to a switch that remain regulated.[33]

The traditional European solution, used in many countries for electricity, rail and telecom services, as well as for other services, has been government ownership of much of the industry. As an example, the main-line Swedish rail tracks were built by the government and the Swedish Parliament nationalised the private rail tracks in 1939. Similarly, the entire telecom network was owned by the government agency Televerket, prior to liberalisation, incorporation of Televerket and the partial privatisation of Telia, as it is now known. The traditional American solution has, instead, been to regulate the prices of privately-owned firms in these industries, often called utilities.

Since the 1990s, the trend has been towards the liberalisation of previously regulated industries and towards the privatisation of previously government-owned firms (Sweden has seen relatively little privatization, but quite a bit of liberalization). Furthermore, an international consensus has developed that regulation should focus on key bottleneck infrastructural services, rather than on consumer prices. For example, instead of regulating the price of electricity delivered to consumers, price regulation is now restricted to the bottleneck distribution service, while the pricing of the relatively competitive electric-power generation industry has been deregulated in many countries. The Swedish high-voltage transmission network remains government owned, allowing a state-owned entity to be the TMO, the Transmission System Operator.

Ideally, firms active in the competitive segments should successively establish their own infrastructure and, over time, become less dependent on the old incumbent, allowing regulation to be devolved step by step. To a large extent, this is what has happened in the telecom industry, where entrants have invested heavily in proprietary infrastructure and, consequently, access regulation has become confined to the segments of the infrastructure where duplication remains infeasible.

In other industries, however, as infrastructure remains difficult to duplicate, it has not been possible to reduce the scope of the regulation (electricity is an example). At the same time, it has become apparent that it is not enough to regulate access prices; key quality characteristics often have to be regulated as well. A regulated firm that owns infrastructure, while also being active in the downstream market, will typically not be interested in selling to its rivals, particularly not if access prices are held down to a low level. The less access it provides its rivals, the better its own downstream competitive situation, the larger its market share and the better its own ability to charge premium prices. As rivals are hurt when the

33 Network operators' charges for call termination also remain regulated, as discussed below. See Commission Recommendation of 17 December 2007 (2007/879/EC); Commission Staff Working Document Explanatory Note Accompanying the document Commission Recommendation on relevant product and service markets within the electronic communications sector susceptible to ex ante regulation in accordance with Directive 2002/21/EC of the European Parliament and of the Council on a common regulatory framework for electronic communications networks and services; and Commission Recommendation of 9.10.2014 concerning the same document, at 25.

quality of access services is degraded, regulation must concern itself not only with prices, but also with the quality of access. This has made regulation quite complex, even when the regulatory scope has decreased. While it may be difficult enough to establish a fair access price, in most settings it is even more complicated to define quality standards for access.

In some markets, the critical infrastructure has been vertically separated from the competitive segments. A firm that owns infrastructure, but that is not active downstream, will not have incentives to distort quality. It will likely be willing to sell to all firms, without discriminating against some of them. Vertical separation has thus been seen as a means of achieving a fair and balanced situation. Sometimes, the government remains the owner of the critical infrastructure (for example, rail track, high-voltage transmission and terrestrial broadcasting networks in Sweden); sometimes, critical infrastructure is privately owned (for example, many of the Swedish electricity distribution networks, as well as critical parts of the telecom network). However, vertical separation is no panacea, for at least two reasons.

Firstly, vertical synergies may be lost. Secondly, and perhaps more importantly, price regulation tends to become laxer when every firm pays the same and no firm is competitively disadvantaged by paying too much. It appears that a regulatory authority, which has to balance the interests of an incumbent that wants high access prices against the interests of entrants that want low access prices, can achieve lower access prices than an authority that regulates an industry without such asymmetries. At least, this is the impression given by a comparison of the Swedish telecom market – with asymmetric ownership of key infrastructure and an adversarial position between the incumbent and the entrants – and the Swedish electricity market, with a much more symmetric situation and where the interests of the regulated firms are aligned.

Besides vertical separation and vertical integration, ownership of the key assets can be structured as an infrastructural club. This was the solution chosen for Visa and Mastercard, prior to 2006, and this remains the situation for critical parts of the Swedish payment system, notably BG, DCL and Swish. An infrastructural club combines some of the advantages of the two polar ownership configurations. It allows some vertical synergies; it creates a level playing field for its owners; and its owners can likely prevent access prices from inflating. However, dominant owners may discriminate against new entrants, or even block them completely. Infrastructural clubs are more open to challenges from competition authorities; this may have been a reason for the restructuring of the ownership of the card networks discussed above.

Two important aspects of the economic regulation of physical assets concern which assets to regulate and how to structure the ownership of the industry and its assets. A third aspect is *how* to regulate. A regulated access price should be set high enough that the owner of the asset has incentives to invest, yet low enough that consumers can benefit from low prices. From an economic point of view, two main principles for calculating such prices are, respectively, rate-of-return regulation (also known as cost-plus) and price-cap regulation.

Rate-of-return regulation caps the (access) price that can be charged at a rate that reflects the sum of the per-unit operating expenditures and capital costs. At its core, the latter is calculated as the permissible rate of return plus the depreciation rate times the asset base. In practice, rate-of-return regulation tends to be complex. All cost components can be contested – and are contested. Is it, for example, up to the regulated firm to determine what capital expenditures to include in the asset base? Or does a new investment need regulatory approval for it to be included in the asset base?

A fundamental concern with rate-of-return regulation is that high costs justify high prices, hence blunting the incentives of the regulated firm to be efficient. As an alternative, therefore, price caps based on historical prices in combination with projected productivity gains have been proposed. If the regulated firm can reduce costs faster than predicted, it can keep the difference as profit. In order to reduce risks, cost components that are not controlled by the regulated firm, such as world-market prices of inputs, can be factored into the price cap.

In principle, price-cap regulation creates strong incentives for cost reductions. In practice, however, the price cap will eventually have to be re-aligned to match actual costs. This means that the difference between rate-of-return regulation and price-cap regulation is really the length of the revision period. Long revision periods make the incentives to cut costs stronger, for capital costs too. Consequently, price-cap regulation tends to give weaker incentives for investment. Conversely, rate-of-return regulation may create excessive incentives to expand the asset base. In 2012, a new regulatory model for electricity distribution in Sweden was introduced, based on rate-of-return regulation, although somewhat misleadingly called a revenue-cap regulation. The previous regulatory model, based on price-cap regulation, was discontinued in 2009, following a debate about underinvestment in the distribution networks, as well as the regulatory authority losing a series of court cases. Since the new model's introduction, investments have risen sharply – as have prices.[34]

From a legal point of view, an important design feature of the regulatory model is whether regulation is retrospective or prospective. Under prospective regulation, the regulatory authority sets the maximum price before the regulatory period begins. If a regulated firm is dissatisfied, it must initiate legal procedures to overturn the regulator's decision. Under retrospective regulation, the regulated firms set prices first and the regulator will have to challenge excessive prices in court. Naturally, the party that is allowed to act first will have an advantaged position; the party that initiates a legal challenge will have to satisfy the evidentiary requirements of the court. Table A1 provides examples of how prospective and retrospective regulation have been combined with price-cap regulation and rate-of-return regulation in Sweden.

Table A1. Combinations of regulatory models; examples from Sweden

	Time dimension of regulation with implications for burden of proof		
		Prospective	Retrospective
Basis for calculating maximum permissible price	Price cap	Telecom access regulation[35]	Electricity networks, prior to reform
	Rate-of-return regulation	Electricity networks, after reform	Competition law applied to access pricing

Competition law's main thrust is to prevent market power from arising in the first place. By contrast, (economic) regulation aims to limit an already dominant firm's ability to use its market power to set high prices. In some situations, however, competition law can be used to regulate access prices. Technically, a dominant firm's refusal to provide access at reasonable prices can be construed as (illegal) abuse of dominance. The strength of competition law is its flexibility. In principle, it can be used to regulate the behaviour of any sufficiently dominant firm. Its weakness is that the 'regulation' will be weaker – and sometimes much weaker – than an economic regulation tailored for that industry. Competition-law-as-regulation will be applied retrospectively, although a retrospective decision will have forward implications.

The application of competition law to MIFs, as discussed above, is a typical example. Through the application of competition law, the MIFs of the two dominant card networks were capped. When economic regulation was introduced in 2015, the cap was extended to all card networks and the scope of the regulation became more extensive.

34 https://www.villaagarna.se/globalassets/dokument/resultat-sammanstallning.pdf; Nätföretagens drivkrafter för investeringar, Rapport till energimarknadsinspektionen, 2017-06-16.

35 Telecom regulation is multi-faceted and contains elements of rate-of-return regulation.

Appendix C. Policy options for market power arising from intangible assets

So far, the discussion has focused mainly on tangible assets; expensive physical infrastructure such as rail track or fibre networks. However, network effects and other intangible assets are becoming increasingly important. Especially prominent are the platforms that dominate the digital markets.

Around the year 2000, the concepts 'two-sided markets', 'two-sided network effects', the 'platform business model' and digital (or online) 'matchmaking' became widely used to describe markets where different types of agents meet and interact and where this is facilitated by a set of assets that constitute a 'platform' controlled by a third party. The platform provider and the platform itself facilitate the interaction, while either or both sides of the market are charged for the services received. Platforms can be digital, but they can also be physical. Sometimes the platform inserts itself in the transaction chain, so that parties on both sides contract with the platform; sometimes the platform just provides the opportunity for parties to contract directly. See Table A2 for examples.

Table A2. Examples of platforms

	Nature of the platform's role: matchmaking only or transaction party		
Nature of the platform's key assets: physical or digital		Matchmaking only	Party to transactions
	Physical	Shopping mall; night club	Telephone networks
	Digital	Blocket (Internet classified ads)	Credit-card network, Amazon

Besides the platform itself, the number of customers or clients on one side of a two-sided market will be critical for its value to the other side of the market. As discussed above, a credit card network is valuable to card holders in proportion to the number of merchants that accept the card; it is valuable to merchants in proportion to the number of card holders that are inclined to use the card. If the network effects are strong enough, if it is costly to use more than one platform and if customers' preferences do not vary too much, there may be a tendency for platform markets to 'tip' – that is, for all customers on at least one of the sides to adopt the dominant platform, once it becomes dominant enough.

Politicians have so far been less willing to regulate platform markets than the owners of physical infrastructure, even when a single platform has become dominant. The 2015 EU regulation of the credit card industry, as discussed above, is an exception. Another exception is the regulation of termination access in telephone networks. Even small network operators are mandated to provide access for incoming calls to their own customers and are not allowed to charge the originating operator more than the maximum rate, as set by the telecom regulator.

Competition authorities, however, have used their tools to intervene in some platform markets. The EU Commission's competition directorate's actions against the international card networks are discussed above. The Swedish Competition Authority has also acted against card networks and it has used competition law to challenge hotel booking platforms.

In special situations, competition law can be used to achieve de-facto access regulation to physical infrastructure. It will not be as forceful as sector-specific regulation and it will only be effective against dominant companies and against agreements between firms, but it requires no sector-specific legislation and can be applied in contexts and situations not anticipated by the legislator. In contrast, economic regulation can apply to relatively small companies that have local monopolies or that act as gatekeepers to particular assets to which other firms need to connect.

Another early example of how competition law has been applied to network industries and platforms is the interest the US antitrust authorities took in Microsoft's operative system Windows and the emerging internet browsers in the 1990s. The operative system was a platform that attracted software developers on one side of the market and individuals and enterprises that owned desktop and laptop computers on the other. Windows was an attractive choice for consumers, as numerous applications had been developed to run on Windows; it was attractive for developers because Windows had a large customer base.

In 1998, the US Department of Justice (DoJ) sued Microsoft for tying the internet browser Internet Explorer (IE) to Windows, in violation of an earlier settlement. Microsoft argued that IE was a feature, not a separate product tied to Windows.[36] According to the so-called theory of harm proposed by the DoJ, the rival internet browser Netscape, in combination with the software Java, represented a threat to Microsoft's dominance on the market for operative systems for desktop and laptop computers – and Microsoft tried illegally to thwart that threat. As Netscape and Java became ubiquitous, software developers would increasingly have incentives to design software that could run on Netscape and Java, hence threatening to make Windows dispensable or, at least, threatening to break Microsoft's near monopoly in the market for operative systems.

Microsoft used a series of anti-competitive practices to stop the growth of Netscape and to boost the market share of its own IE. Although Netscape, initially the market leader, could offer similar features as IE, it failed to overcome the strong network effect created when IE was tied to Windows and the pressure of a range of anti-competitive actions. The first court instance established that Microsoft had used illegal practices and ordered the break-up of Microsoft into two entities, but this was overturned by the appeals court. In a settlement, Microsoft agreed to share so-called applications programming interfaces with third parties but was allowed to continue providing IE for free. The efficacy of this measure for curbing Microsoft's dominance and market power has been debated.

Subsequently, however, Microsoft's grip on the market has been weakened. It is now down to about 75 per cent from about 90 per cent five years ago, although this is mainly due to a technological shift towards smartphones and tablets.[37] Considering all platforms (desktops, laptops, smartphones and tablets), Microsoft is far behind Google's Android operative system and also behind Apple's IOS.

The evolution of the computer and software markets shows that new technologies will eventually leapfrog old monopolies: IBM's hold on the market was superseded by Microsoft and the rise of desktop computers, which, in turn, was challenged by Google's Android system and Apple's IOS. Although these companies are now, in turn, under scrutiny for anti-competitive practices, it is likely that they will eventually be challenged by new rivals building their strength on new yet-to-emerge technologies.

However, it is also apparent that significant competition problems can persist for many years before a new technology emerges. The companies that have replaced Microsoft as the new dominants in the tech market – Facebook, Google and Apple – are accused of stifling competition in the markets they have come to dominate and are now attracting the attention of competition authorities.

36 Tying is an arrangement where, in order to buy one product, the consumer must purchase another product that exists in a separate market. One way to achieve a tie is to bundle two products, so that one (the tied product) comes with the purchase of the other (the tying product). Tying by a dominant firm can be a violation of competition law.

37 https://www.statista.com/statistics/218089/global-market-share-of-windows-7/