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# Competition Policy and the Financial Technology Revolution in Banking

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**Abstract:** This paper argues that the more ambitious prognostications of the outcome of the current 'FinTech' revolution, a transformation of banking to the benefit of customers, depend critically on the appropriate use of competition law and policy, in particular the regulation of access to banking platforms. Without supportive intervention of this kind by regulators and central banks to promote incentives for adoption, for example through requiring standardised information exchange through 'application programming interfaces' (APIs) and widening access to central bank money, incumbents are likely to successfully resist substantial change.

**Key words:** Access regulation, APIs, central bank money, competition law, incentives for innovation, financial infrastructure, financial technology, network economics, payment schemes, payments governance, platform competition, RTGS, SEPA, technology adoption.

**JEL codes:** G21, L86, L88

## Introduction

Are we on the brink of a 'FinTech' based disruptive revolution in banking? Such transformative change has indeed happened in many other industries (see CHRISTENSEN AND RAYNOR (1997, 2013)). A combination of new security and communication technologies – the internet and digital signature – together with changing customer attitudes – the millennial

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generation who are comfortable with virtual conduct of almost all their transactions – suggests that banking may also now also ripe for profound technology driven change.

There are though reasons for scepticism. Predictions of transformative technological change in banking have been made in the past and yet the industry has clung to old structures and old ways of doing things. To choose one example, IBM INSTITUTE FOR BUSINESS VALUE (2005) painted a picture of dramatic technology and customer driven change in banking over the decade 2005-2015 which never took place. One explanation for this slow rate of change is that adoption of new technology in banking requires co-ordinated change and so, as a result, incentives for adoption are comparatively weak (this argument developed in MILNE (2006, 2007) is stated more fully below).

This paper argues that technological developments have indeed matured to the point where dramatic change in banking and other financial services is possible – but for this to happen requires public policy intervention to overcome the barriers to accessing both proprietary and shared banking platforms that otherwise undermine incentives for technological innovation and adoption. Firm and far sighted action by both central banks and competition regulators will be needed to open up key monopoly elements to potential competition and hence create incentives for innovation. This will take time – the FinTech revolution in banking will not be as rapid as some suppose. But if policy intervention is supportive then technology driven change in banking will eventually be profound.

## The promise of financial technology

Innovative Financial Technologies are now attracting substantial investor interest. ACCENTURE (2016) report a cumulative \$50.1bn of venture capital funding for Fintech start-ups in the years 2010-2015 with \$22.3bn of funding in 2015 alone. FinTech is being applied to a remarkable range of different activities (see Figure 1). These entrepreneurial effort is particularly great in five areas: capital markets technology

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(facilitating the buying and selling of financial securities for professionals); payments (payments process, cutting processing costs, enabling digital currencies to become reliable and mobile phone payment); data analytics (leverage big data for financial matters as risk management; fraud detection and credit monitoring); bank credit & corporate financial information (complementing or disrupting traditional banking and corporate finance processes such as loan origination and corporate accounting and cash management); and personal finance management (manage stock portfolios, personal budgets and taxes through technology).

To date the most dramatic developments have taken place outside of mainstream banking. M-Pesa in Kenya has been a pioneer for mobile based monetary transfer in emerging markets, allowing money transfer outside of the banking system and allowing millions without bank accounts to move from 19<sup>th</sup> century paper money to 21<sup>st</sup> century digital money in a single leap (MBITI and WEIL (2011)). Bitcoin has demonstrated the possibility of a secure software based virtual cryptocurrency without any central issuing authority at all (an account of the underlying technology is provided by NARAYANAN, BONNEAU, FELTEN, FELTEN, & GOLDFEDER (2016)).

Financial Technology has particular promise as a means of achieving European Union policy objectives, promoting the single market in financial services and, in particular, the goals of 'Capital Markets Union', 'Banking Union' and the provision of risk finance to smaller innovative companies. MILNE (2015) has argued that – with appropriate measures to support pan-European standards – FinTech can play a crucial role in achieving European policy objectives.

Despite these exciting possibilities, most customer experience of FinTech in the developed world is of gradual exploitation of new possibilities by incumbent institutions. The major banks are slowly and cautiously developing new parallel technology based channels for service delivery. Examples include online and mobile- banking applications or point-of-sale payment or the point of sale payment services on mobile telephones. These

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developments offer customers greater convenience but are far from challenging the position of incumbent institutions.

There are a few examples of successful competition from non-banks, a range of alternative financial products such as peer-to-peer lending (developments in alternative finance in Europe, the Americas and the UK respectively, are summarised by WARDROP, R., ZHANG, B., RAU, R., & GRAY, M. (2015), WARDROP, ROSENBERG, ZHANG, ZIEGLER, SQUIRE, BURTON, AND GARVEY (2016) and ZHANG, BAECK, ZIEGLER, BONE & GARVEY (2016)). Alternative non-bank providers of foreign exchange transactions such as CurrencyFair and Transferwise provide much cheaper services for retail customers than incumbent banks. 'Peer to Peer' lending platforms have grown rapidly, First in the UK and the US and subsequently in other countries. Despite these developments market shares of these non-bank competitors still remain relatively small. Overall, despite the excitement and the wide range of new initiatives, we are still some way still from seeing a truly transformative impact of FinTech on banking.

## **F**inancial networks and the weak incentives for innovation

An explanation for these slow rates of technological innovation in banking is provided by MILNE (2006, 2007). Those papers focus on payments technologies, but the point is a more general one: the network structure of financial services means that the adoption of innovation requires co-ordination amongst many competing institutions. Even when all institutions benefit such co-ordination is problematic. In practice there are usually losers whose profit margins depend on helping customers overcome technological inefficiencies. Those losers will be especially reluctant to agree to technological innovation that substitutes for their services. The result is a market failure, innovation in financial services suffers from

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'excess inertia' (FARRELL AND SALONER (1985)) relative to the socially optimal outcome.

MILNE (2006, 2007) develop the example of retail payments. For a payment to be transmitted from an account held by customer a in Bank A to an account held by customer b in Bank B, the banks must agree on the instructions required for initiation of the payment and on the arrangements for settlement. Such agreements are encapsulated in payment schemes – covering debit and credit cards, credit transfers, direct debits, ATM withdrawals and others. Getting agreement on innovation in payments schemes is difficult because no individual bank gains any competitive advantage from innovation, even where these changes benefit customers.

The same argument applies to other banking and financial services. The assessment of retail credit risk depends on access to histories of past loan applications and loan repayment. Banks have collaborated or worked with public authorities on developing credit registers that contain this essential information. But they can be reluctant to share customer information as fully as possible with other banks or to support developments that widen access to this information to non-bank providers of credit.

Similar issues affect innovation in capital markets, although there platform access is sometimes supported by agreed communication protocols, for example those managed by Fix Protocol Ltd that support instructions for equity trades (see OXERA (2009)). But in many other areas of global capital markets firms have been reluctant to agree such standards, again because of concerns about loss of margins.

More often than not the innovation in financial services that has taken place piggy backs on existing arrangements, rather than challenging them. Examples in retail payments include PayPal and the recent emergence of ApplePay and AndroidPay for point of sale mobile payments. PayPal offers convenient transfer of payments within a closed environment of PayPal accounts, but the introduction or withdrawal of purchasing power for use elsewhere requires a link to a bank account and the charges for so doing

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can be high. ApplePay and AndroidPay are based on the relatively old NFC contactless technologies, supplemented by additional security on the phone and in transmission of payment instructions. As they require linkage to a bank transactions account, these are in effect a means for securely embedding a debit card within a mobile phone, unlike M-Pesa in Kenya these are not a fundamental challenge to existing bank payment arrangements.

Weak incentives for innovation also help explain why most long established banks continue to struggle with managing and maintaining a huge body of legacy software, rather than replacing with integrated systems. This is especially problematic for larger institutions that have acquired many smaller competitors over past decades. TECH UK (2015) have highlighted the difficulties of change: “One UK retail bank is running 6,700 applications on over 80,000 servers. This multitude of applications slows down any attempt at change or modernisation.”

It might be thought that banks would gain substantially from a replacement program, substitution a single operational system in any particular product area, for a host of inherited legacy systems. But systems investment is costly, in part because of the need to maintain the relatively complex interactions with industry payment, credit and other networks. Also such wholesale change is risky – any failure of customer service provision would result in substantial reputational damage. Furthermore, while systems upgrade can reduce costs, it is difficult to extract revenue benefits since customer experience is not directly affected by underlying operational systems. For all these reasons the costs and risks of large scale system upgrade have largely continued to outweigh any commercial benefits.

The weak incentives for innovation, rooted in the network structure of banking and other financial services, mean that the future impact of FinTech on the banking industry is uncertain. Without action to address the market failures associated with the shared networks undermining the incentives for technology adoption, the impact of FinTech on the banking industry is likely to remain peripheral with little impact on core activities.

## C ompetition policy and innovation in network industries

This section briefly reviews the theory of competition policy as applied to three network industries: household utilities, telecommunications and banking, discussing the implications for innovation and dynamic efficiency. This theory will then be applied in the following section, investigating ways in which access regulation can increase incentives for the adoption of new financial technologies in banking.

The definition of network industries is a broad one, it includes any industry where either producers or consumer decisions are interdependent, with the cost of production or the utility from consumption depending not just on price and quantity but also on the production and consumption decision of other network participants (for further discussion see for example ECONOMIDES (1996)). The presence of such 'network externalities' is associated with market failure, unregulated competition does not produce an optimal outcome (the outcome is 'pareto sub-optimal' i.e. appropriate policy intervention may be able to improve on the welfare of some market participants without any loss of welfare to others.) The particular market failure highlighted by the present article is lack of incentives for adoption of new financial technologies (though many other outcomes are possible).

Wideranging research and debate in the 1980s and 1990s addressed how best to promote competition and efficient pricing and investment in household utilities. This challenge emerged in large part because of the large scale program of privatisation, begun by the Thatcher administration in the UK but later pursued by many governments worldwide. The key problem was how to ensure that profit-orientated providers in a network industry such as gas or electricity did not exploit their market power in order to extract high profits from consumers.

Figure 2 illustrates the key insights that emerged two decades or more ago from this policy discussion. The first attempts at regulation of privatised utilities was based on price controls, typically on a cost-plus basis. The problem with that approach was that it undermined incentives to lower the



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costs of supply and – if the prices were set too low – also made investment in new capacity unprofitable. So a consensus emerged that is illustrated in Figure 2. A better approach by competition authorities was to distinguish the potentially competitive markets (market 2) e.g. generation of electricity and also customer services from the monopoly sector created by reliance on a shared network (market 1) e.g. the physical network used to carry gas or electricity to households. It became apparent that a better approach to regulation was regulation of access to and pricing of the shared network, allowing for competition in the potentially competitive sector.

The situation in most telecommunications and banking services is more complicated than that found in household utilities and more difficult to illustrate graphically. Both mobile telecommunications and banking are both characterised by platform competition. In order to make payments or complete telephone calls consumers need a service that links to consumers on other platforms not just their own. In some contexts this can lead to ‘co-competition’: collaboration between producers that promotes access to each others networks and benefits consumers (SPIEGEL (2005)).

Access of regulation is a key instrument of competition policy applied both to household utilities and in the telecommunications industry, Authorities in both Europe and the US authorities have found it appropriate to introduce tailored regulatory regimes, with a legal framework that can allow them to regulate cross-platform access. While intervention has varied substantially both over time and between countries, access regulation has continued to play a major role in promoting competition and encouraging innovation (for discuss of the US see HAUSMAN AND TAYLOR (2013)).

For banking regulatory policy has largely focused on prudential safety and customer protection rather than promoting competition and innovation. Competition interventions have until recently been based on the application general competition law, rather than on specific regulatory framework tailored to the specific network features of banking and other financial services. Examples include interventions to require disposal of bank branches to prevent institutions havng such a large market share that

they might abuse a dominant position. The governance arrangements of payment schemes have also been subject to regulatory investigation under general competition law (see MILNE (2007) for the case of the UK). The credit and debit card payment arrangements have also been subject to similar inquiries in a number of jurisdictions. Payment schemes have also for example sometimes been required to provide more favourable terms of access to smaller ‘challenger’ institutions. But all these remedies are generally viewed as having only limited impact on banking sector competition and innovation.

As discussed in the following section, authorities are now beginning to address seriously the challenge of regulating access to banking platforms, addressing more fully the implications of banking networks for competition and innovation, a key step if the full potential benefits of FinTech are to be realised.

## **S**upporting FinTech through access regulation

Having discussed the implications of network structure for competition policy and regulation, in household utilities, telecommunications and in banking, this section considers two ways in which public authorities can apply access regulation, in order to ensure that full realisation of the potential of FinTech for improving services to bank customers and reducing bank costs and risks. This access regulation in respect of financial platforms, is critical in order for technology based innovation to compete effectively with incumbent banks. A start is already being made through the EU Payments Service Directive 2 (PSD2) and other measures on one form of access regulation, requiring banks to provide open-APIs to give third party access to their platforms and data. Much more remains still to be done in respect of the second form of access regulation, widening access to central bank money. In both cases the benefits will not be achieved from a one-off measures, this will require sustained regulatory oversight.

e-APWG (2016) provides an overview of the role of APIs (or “Application Programming Interfaces”) in utilising information technology in banking. To

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quote from this report “APIs can be seen as interfaces between software applications, both within as well as between organisations. More specifically: APIs enable communication between software applications where one application calls upon the functionality of another application. Every API is an interface, but not every interface is an API. API is a specific software architectural approach that revolves around the view that interfaces should be **scalable**, **reusable** and **secure** while offering ease of use for developers.”

It is best to distinguish two forms of API: internal and open. Internal APIs provide an interface between a bank’s own customer service applications and underpinning operational systems. These underpinning systems are often mainframe applications that have changed little since first being commissioned in the 1970s or 1980s. Larger banks that have grown through acquisitions can easily have several operational systems which can be bridged through APIs. Gains in operational efficiency provide strong commercial incentives for using internal APIs as the interface with these older legacy systems.

Open-APIs differ from internal APIs because they are interfaces *between* organisations. It is here that the key issues of access regulation to bank’s internal platforms and data arise. This has already been recognised in the European Union where the second EU Payments Service Directive (PSD2), agreed by the European parliament in 2015, requires EU banks to provide open-APIs for payment services by October 2018. The directive requires both (i) that payments initiated via third party services through APIs must offer enhanced authentication of customer identity to avoid fraud; and (ii) that third parties must with customer agreement have access to transaction requests, to balances and to transaction history. Further functionality is also expected in relation to third party access to information on payment services fees and on additional protections to protect customer interests e.g. limits on larger value payments.

The perception that APIs can be used to promote competition in banking has been taken a step further in the UK, where HM Treasury established an

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Open Banking Working Group that had developed a standard for 'open banking' (THE OPEN BANKING WORKING GROUP (2016)) in which APIs are used to provide third parties with wide ranging access to bank platforms and data, not just payments. This has in turn been taken up in the final report of the COMPETITION AND MARKETS AUTHORITY (2016) of the recently concluded two-year investigation of competition in UK retail bank. This final report is supporting open banking by requiring banks to release and make available through an open-APIs, by the end of Q1 2017, and thereafter maintain as open data, a wide range of reference and product information, including (i) the prices, charges, terms and conditions for all personal and business current account products (including overdrafts) and small business lending products; and (ii) service quality indicators (for example customer recommendation scores) specified by the CMA in its remedy on service quality and at the time required by this remedy. In addition they plan that banks provide open-APIs with full read and write functionality payment and transaction data not later than the October 2018 deadline for compliance with PSD2.

As argued by CORDET, RIJKS and NIJLAND (2016) PSD2 can be expected to accelerate technological change by forcing banks to use APIs to open up consumer payment accounts for appropriately licensed, innovative service providers. It will also be a fundamental strategic challenge to incumbent banks, who will have to focus on ensuring they exploit the opportunities of technology to improve customer experience. PLEITER, J., & DE JONG, J. (2016) provide an overview of the strategic issues. They argue that banks face a choice between a pro-active response – taking up the opportunity to collaborate with third parties to enhance customer services-- or a reactive response, limiting themselves to regulatory compliance but risking loss of market share and revenue to more nimble and innovative competitors.

It is worth briefly mentioning some examples of the innovations that are likely to be supported by open-APIs and open banking. One possibility is much improved third party aggregation of banking products, which would make it possible to hold and compare a number of accounts and

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investments provided by different institutions within one portal. Third parties, with appropriate permissioning, could be allowed to change and initiate payment instructions.

This kind of innovation should also provide an effective competitive challenge to the high charges imposed by card schemes for international transactions, which can cost consumers as much as 5% or more of transaction value and add quite a lot to the cost of an overseas visit. An aggregator service can allow a consumer to link a pre-paid card that avoids these high charges to their bank account, with transfers that maintains the pre-paid balance at a level sufficient for daily needs, with excess returned at the close of the trip.

Another innovation is access to the shared credit information, including payment histories, that is critical to making loan approval decisions. SMEs that are refused credit by banks that provide them with payment services can look to obtain credit from alternative providers through sharing of their payment histories.

Overtime aggregation tools may also substantially alter competition in the full range of payments services, whether business to business (B2B) or consumer to business (C2B); and whether online and in person. Security concerns are naturally prominent, so these developments must be pursued slowly and carefully, but APIs are also potentially security enhancing.

The second access issue is the potential promotion of competition through giving non-bank payment service providers access to central bank money, the underlying settlement asset for payment transactions. At present it is only banks that can offer final settlement of payments in central bank money, whether for payors (recipients of funds) or payees (senders of funds). This means that only banks can offer final settlement of payments from payor to payee, non-banks without such access are forced to pay relatively high bank charges in order to settle payments indirectly through banks.

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This is another example of access regulation: the competitive position of payment services provided by non-bank providers such as those offering alternative foreign exchange is fundamentally different if they can directly transact in central bank money and so bypass the need to relying on a bank to complete the final leg of a payment.

While not yet pursued through practical policy measures, the possibility of allowing non-bank payment service providers direct access to central bank money is now being actively discussed. Most notably the Bank of England has recently announced that it will allow such access (CARNEY (2016)), although the operational details of this access have yet been publically announced. Still, this is of great potential significance to non-bank provision of mobile and foreign exchange payments.

To give one example, alternative foreign exchange providers such as Transferwise sometimes have structural imbalances in international payment flows. From personal communication I understand that while Transferwise transactions between pound sterling and Euro are largely balanced and so net out with only small balances that must be transacted in wholesale markets, for other currency pairs, e.g. sterling against Indian rupee, there is a structural flow in one direction. In this case, in order to provide near mid-market pricing to customers Transferwise need to be able to access wholesale foreign exchange markets on the same terms as their bank competitors. Direct transactions in central bank money gives the ability to do this. The development is directly analogous to the access regulation of the monopoly market in household utilities illustrated by Figure 2. Access to central bank money supports potential competition in the consumer markets such as foreign exchange transactions. A similar opening up to competition can also be expected in for example mobile payments, allowing alternative mobile payments to develop with much lower charges to retailers than for example ApplePay or PayPal.

In both these cases, APIs and central bank money, there is devil in the detail. While application to payments services are already taking place, through PSD2, many of technical rules are still to be finalised. While the

thrust of PSD2 – opening up access to bank’s own internal platforms and data – is welcome, it remains to be seen how effective is the enforcement of the directive. While banks will certainly have to introduce open-APIs to comply with the directive, it remains to be seen how well this will serve the requirements to third party competitors and other banks who seek to access the bank’s platforms and data to offer competing services to customers. The situation is very different from that of say Uber using an open-API to embed google maps into their taxi-booking service, because these third party competitors will want to access the open-APIs of many banks not just one. Will standardisation be possible so that different bank open-APIs do offer uniform performance? What steps are needed to both achieve and enforce these standards?

Even more questions surround access to central bank money for non-bank payment service providers. This is fine sounding in principle, but it has not yet been implemented practically and there are many questions about the extent to which this will allow FinTech innovators to participate in or compete with incumbent banks. For example what charges will they face for transferring central bank money into or out of the bank accounts of customers and will supporting price regulation be required?

These considerations make clear that the access regulation of banking platforms by competition regulators and other public authorities is a one-time effort. A good start has been made, especially through the requirement for open-APIs in PSD2, but achieving the goal of ‘open banking’ which supports wide ranging technical innovation to lower costs and improve customer experience, will require sustained oversight by competition and regulatory authorities to ensure effective standardised access to all the platforms used in the delivery of banking services.

## onclusions

This paper has examined the current wave of FinTech innovation from a network economics perspective, arguing that regulation of access to banking platforms is an essential pre-requisite for new FinTech ventures to

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provide truly effective competition to incumbent banks in the provision of payment, credit and other services. The situation parallels that of other network industries, especially telecommunications, where access regulation is also necessary in order to support competitive service provision and technological innovation.

Two forms of access regulation have been highlighted. The first is the requirement for banks to provide 'open-APIs' that support third party access to their internal platforms and data. An important first step on this form of access regulation is the European Payments Services Directive 2 (PSD2), with banks having to comply by October 2018. In the UK the potential for using 'open-APIs' to promote bank competition and innovation is being taken further through the creation of the Open Bank Standard and the recommendations of the recently concluded competition inquiry into retail banking. Much of the required detail however, in order for open-APIs to be fully effective as a tool of access regulation, is still being worked out. A continued further regulatory effort will be needed to ensure that banks do offer third-parties the kind of access that allows them to effectively compete in the provision of payment and other services.

The second form of access regulation highlighted here is the access to the central bank money that is required for final settlement of payments between customers. At present non-bank technology based competitors have to rely on and pay banks for the service of final settlement. In some cases, for example alternative foreign exchange, this is a serious impediment to developing a technology based service that competes with incumbent banks. Central banks world-wide are now starting to entertain the possibility of allowing non-banks the opportunity to transact directly in central bank money, with the Bank of England now committed to allowing such access to some non-bank firms.

These efforts at access regulation are critical for the future of FinTech. The experience of banking and other financial services, discussed briefly here, illustrates how incentives for innovation have in the past been weak. Banks have had unchallenged control over their own proprietary platforms and



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data- Banks have been the only providers of the essential final link the settlement of payments. For these reasons non-bank providers of technology based credit and payment services have struggled to compete with incumbent bank, while banks themselves have obtained little competitive advantage to gain from technological innovation.

Without effective access regulation incumbent banks will be able to effectively resist the FinTech challenge. The new entrepreneurs will be limited to serving niche markets that banks serve inadequately or not at all. Banks will use technology to lower costs in existing bank channels and to provide new internet and mobile based access to banking services. But these developments will represent only an evolution of existing practice not a transformation.

With effective access regulation, banks will face strong competition from a range of new FinTech providers, offering lower cost and more convenient payment and credit services. This will in turn require banks to respond, those who successfully cope will be the banks that respond pro-actively, seeking to work with non-bank FinTech providers to improve their own customer experience.

Finally it must be recognised that effective access regulation, giving competitors standardised and low cost access both to internal bank platforms and data and to transactions in central bank money for payments settlement, is not just a matter of legislation or a one-time change of rules. Implementation matters. Left to themselves banks have little incentive to implement in a way that ensures non-bank competitors have low cost access to banking platforms. Effective access regulation requires sustained regulatory oversight and co-operation between industry and the authorities to address barriers to platform access when and where these arise.

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## References

ACCENTURE (2016). *FinTech and the Evolving Landscape: Landing Points for the Industry*. Retrieved from [http://www.fintechinnovationlablondon.co.uk/pdf/Fintech\\_Evolving\\_Landscape\\_2016.pdf](http://www.fintechinnovationlablondon.co.uk/pdf/Fintech_Evolving_Landscape_2016.pdf)

ARMSTRONG, Mark, COWAN, S. AND VICKERS, John., (1994), *Regulatory Reform: Economic Analysis and British Experience*, MIT Press

BROADBENT, B. (2016). Central banks and digital currencies. Bank of England. Retrieved from <http://www.bankofengland.co.uk/publications/Pages/speeches/2016/886.aspx>

CARNEY, M. (2016). Enabling the FinTech transformation: Revolution, Restoration or Reformation? Speech by the Governor of the Bank of England. Retrieved from <http://www.bankofengland.co.uk/publications/Documents/speeches/2016/speech914.pdf>

COMPETITION AND MARKETS AUTHORITY. (2016). *Retail banking market investigation: final report*. London. Retrieved from <https://assets.publishing.service.gov.uk/media/57a9c52b40f0b608a700000a/retail-banking-investigation-full-final-report.pdf>

CORTET, Mounaim; RIJKS, Tom; NIJLAND, Shikko (2016): "PSD2: The digital transformation accelerator for banks", *Journal of Payments Strategy & Systems*, Spring 2016, pp. 13-27(15)

e-APWG. (2016). *Understanding the business relevance of Open APIs and Open Banking for banks*, Euro Banking Association

ECONOMIDES Nicholas. "The economics of networks." *International journal of industrial organization* 14.6 (1996): 673-699.

FARRELL, J., & SALONER, G. (1985). Standardization, Compatibility, and Innovation. *The RAND Journal of Economics*, 16(1), 70–83.

BELLOC, F., NICITA, A., & PARCU, P. L. (2013). Liberalizing telecommunications in Europe: path dependency and institutional complementarities. *Journal of European Public Policy*, 20(1), 132–154.

GRAJEK, M., & RÖLLER, L.-H. (2012). Regulation and investment in network industries: Evidence from European telecoms. *Journal of Law and Economics*, 55(1), 189–216.

HAUSMAN, J. A., & TAYLOR, W. E. (2013). Telecommunication in the US: from regulation to competition (almost). *Review of Industrial Organization*, 42(2), 203–230.

IBM INSTITUTE FOR BUSINESS VALUE (2005) “*The Paradox of Banking 2015: achieving more by doing less*”. Retrieved from <https://www-304.ibm.com/easyaccess/fileservice?contentid=98335>

MBITI I. & WEIL D. N. (2011). *Mobile banking: The impact of M-Pesa in Kenya*. National Bureau of Economic Research.

MILNE Alistair (2006): "What's in it for us? Network externalities and bank payment innovation", *Journal of Banking and Finance*, 30, pp. 1613-1630

MILNE Alistair (2007): "Governance and Innovation in UK Payments", *Communications and Strategies*, No. 66, 2nd Q. 2007

MILNE Alistair (2015). *Achieving European Policy Objectives through Financial Technology*. Retrieved from <https://www.ceps.eu/publications/achieving-european-policy-objectives-through-financial-technology>

NARAYANAN, A., BONNEAU, J., FELTEN, E., FELTEN, A., & GOLDFEDER, S. (2016). *Bitcoin and Cryptocurrency Technologies*. Princeton University Press.

OXERA. (2009). *What are the benefits of the FIX protocol?* Oxford, UK. Retrieved from <http://www.oxera.com/Publications/Reports/2009/What-are-the-benefits-of-the-FIX-Protocol.aspx>

PLEITER, J., & DE JONG, J. (2016). PSD2: Making it actionable. Backbase. Webinar retrieved from <http://blog.backbase.com/4598/yesterdays-webinar-psd2>

---

SPIEGEL, Menahem. (2005). Coopetition in the telecommunications industry. In M. A. Crew & M. Spiegel (Eds.), *Obtaining the best from regulation and competition* (pp. 93–108). Kluwer Academic Publishers.

TECH UK. (2015). Taking the Initiative: Leading with Technology in Financial Services. Retrieved from <https://www.techuk.org/insights/reports/item/4638-techuk-urges-financial-services-industry-to-get-digital-faster>

THE OPEN BANKING WORKING GROUP (2016). *The Open Banking Standard*. Retrieved from <https://www.scribd.com/doc/298569302/The-Open-Banking-Standard>

UK COMPETITION AND MARKETS AUTHORITY (2016): “Investigatio of Retail Banking: Provisional Decision on Remedies” Retrieved from [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/523755/retail\\_banking\\_market\\_pdr.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/523755/retail_banking_market_pdr.pdf)

WARDROP, R., ZHANG, B., RAU, R., & GRAY, M. (2015). *Moving Mainstream: The European Alternative Finance Benchmarking Report*.

WARDROP, R., ROSENBERG, R., ZHANG, B., ZIEGLER, T., SQUIRE, R., BURTON, J., AND GARVEY K. (2016). *Breaking New Ground: The Americas Alternative Finance Benchmarking Report*

ZHANG, B., BAECK, P., ZIEGLER, T., BONE, J., & GARVEY, K. (2016). *Pushing Boundaries: The 2015 UK Alternative Finance Industry Report*.

Figure 1: The Enterprise Opportunity, documenting the new wave of FinTech. This figure (by New Finance Innovations Limited and taken from (Zilgalvis, 2014)) provides a colourful illustration of the range of new FinTech activities.

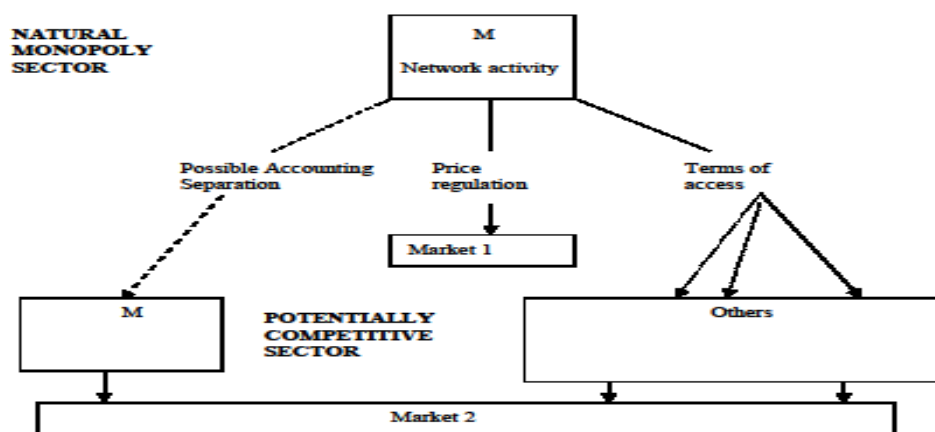
## The UK FinTech Strategic Space 2014



 **New Finance**  
Financial Innovation through Technology

Source: Eddie George, New Finance Innovations Ltd. (2014).

Figure 1: Vertically related markets with a natural network monopoly.



Adapted from ARMSTRONG, COWAN AND VICKERS (1994). M is a monopolist controlling a network. Market 1, if it exists, is the upstream monopoly market supplied only by the monopolist. Market 2 is the downstream potentially competitive market, where competitors require access to the network in order to supply the market.

Figure 2.

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