Ex Post Assessment of European Competition Policy:

The *Microsoft* cases

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1 Introduction

This paper assesses the effectiveness of remedies implemented in two landmark cases that the European Commission brought against Microsoft, namely the Microsoft workgroup server and windows media player case (Microsoft I) and the Microsoft Internet Explorer case (Microsoft II).

These cases arguably formed the basis and intellectual framework for the European Commission's modern day scrutiny of digital platforms.[2] In various respects, these cases presented the first opportunity for the European Commission and the General Court to assess concepts such as dynamic competition, network effects, interoperability, platforms, and multihoming under the EU competition law framework in an in-depth manner. As such, these cases are also likely to prove important precedents for finalization and application of the European Commission's recent DSA and DMA legislative proposals.

However, while frequently cited for their substantive analysis, much less has been said about the effectiveness of remedies imposed in these cases: assuming that the Commission identified valid antitrust concerns, did it succeed in addressing those concerns through effective remedies? How does one measure effectiveness in these cases, and to what extent did effectiveness of the remedies hinge on the legal choice of theory of harm? If the remedies were not effective, what if anything could these cases teach us for future antitrust enforcement?

The purpose of this paper is to offer a preliminary assessment of some of these questions.

The focus of our analysis will be on the direct impact of remedies on the affected markets in terms of addressing the theories of harm ("ToH") identified by EC. In particular, our analysis focuses on the behavioural remedies imposed by the Commission rather than on the imposition of fines. We apply Paolo Bucciroci's concepts of assessment of outcome v assessment of analysis.

Of course, as already alluded to above, the Microsoft cases may well have had a deterrence impact beyond the behavioural remedies imposed in these cases. For example, the substantial fines imposed by the European Commission in *Microsoft I* may well have sent a strong signal underscoring the importance of EU antitrust compliance more generally, and specifically for large platforms. Irrespective of their actual effectiveness, the mere prospect of being required to change one's business conduct following the imposition of behavioural remedies may also deter companies from engaging in anti-competitive conduct. Further, irrespective of fines or behavioural remedies, the legal and economic analysis supporting the Commission's cases may help other firms avoid an infringement. Nevertheless, these more indirect deterrence effects on others are more difficult to assess and quantify than the direct effects of the remedies, and fall outside the scope of this paper.

We have structured our analysis around the legal and economic concepts at issue in Microsoft I and II. For this reason, we assess the interoperability element of Microsoft I separately (section 2) and the tying element of Microsoft I and II jointly (section 3).

[2] L. Crofts, "Microsoft showdown opened the 'floodgates' for EU's Big Tech cases, Madero says," *MLex* 14 December 2020.

2 ToH1: Interoperability

2.1 Legal and economic concerns

The *Microsoft I* case concerned competition in workgroup server operating systems – computer programs that run server computers at the backbone of organizations' computer networks. In order to function properly, workgroup server operating systems must communicate – or interoperate – with the client PC operating systems run on individual PCs in the organization's network. The concerns raised by complainant Sun Microsystems ("Sun") were, in essence, that Microsoft used its Windows PC operating system dominance to foreclose the separate market for workgroup server operating systems by refusing to supply Sun and others with critical information on the protocols that Windows used to communicate with workgroup server operating systems – thus enabling Microsoft to reserve this market to itself.

In particular, Sun alleged, and the Commission agreed, that Microsoft had thus successfully eliminated virtually all of its competitors in workgroup server operating systems, leaving only marginal, ineffective competitive constraints in place.

In its 2004 Decision, the Commission in essence found that Microsoft was dominant in client PC operating systems, where its Windows operating system ran [90+%] on PCs. Crucially, the Commission dismissed Microsoft's Schumpeterian defence, according to which Windows' success was only temporary and its position constrained by the constant threat of entry by rivals.

The Commission's concern with respect to Microsoft's conduct was one of leveraging: namely, Microsoft seeking to transfer market power in the market for PC operating systems to the market for work group server operating systems by limiting the ability of rivals in the latter market to supply products compatible with Microsoft's products in the former market.[3] The Commission in essence found that Microsoft's interoperability information constituted an essential facility, and that Microsoft's refusal to provide rivals access that information amounted to an unlawful refusal to deal contrary to Article 102 TFEU.

Essential facility-type claims face a high standard of proof, and the Commission's Decision set out in detail why Microsoft's interoperability information was not merely important but indeed indispensable for rivals viably to compete in workgroup server operating systems, providing a detailed assessment of foreclosure in the market.

Incentives to innovate. A common concern underlying essential facility cases is that forcing a dominant firm to share facilities with rivals can undermine incentives to invest on the part of both dominant firms – who are faced with the prospect of having to share the fruits of their innovation investments – but also of rivals, who, instead of innovating themselves, can rely on the efforts undertaken by the dominant firm. The Commission thus assessed Microsoft's defence according to which imposing a duty to deal on Microsoft would diminish its incentives to innovate.

[3] *Microsoft* Judgment, para 306.

The Commission expressed the view that Microsoft's incentives to innovate would not materially be undermined by imposing a duty to license. The key finding underlying this conclusion was that Microsoft was not being required to license any of its software code, but only information *about* that software – conversely, rivals would not use the interoperability information to clone Microsoft code, but instead needed the information to develop their own workgroup server operating systems. An analogy could be drawn to cases involving access to network infrastructure, such as rail networks: while mandated access to the rail network for new network operators would undermine incentives to innovate in competing rail networks upstream, it does enable rivals to offer new and innovative rail services downstream, for example, by using new rolling stock or offering rail services at more convenient times.

These cases – Microsoft I included – thus essentially involve a trade-off not only between protecting incentives to innovate on the part of rivals v. incentives to innovate on the part of the dominant firm, but also balancing incentives to innovate in an upstream product or service – here, interoperability information – with incentives to innovate in a downstream product or serve – here, workgroup server operating systems. The Commission's assessment was that the need to protect Microsoft's and third parties' incentives to innovate in the (upstream) interoperability information was outweighed by the need to protect third parties' incentives to innovate in (downstream) workgroup server operating systems.

That finding does raise the risk of encouraging free riding behaviour and a deleterious impact on dynamic innovation incentives. By granting interoperability access to Microsoft's rivals, this lessened the incentive for those rivals to make investments in establishing their own forms of interoperability. Where the alternative to innovation is access via an interoperability remedy, rather than no interoperability, the incremental benefit to innovation may be significantly reduced, lessening the incentive to invest in such innovation. This may prevent alternative and innovative products from emerging, and instead encourage a more limited market equilibrium whereby firms compete on the basis of common mandated access solutions. This may harm dynamic competition encouraging the development of new products even if it achieves a short term benefit in terms of increased static competition amongst firms supplying similar products.

This trade off between short and long term effects from a regulator's point of view will depend in part upon the extent to which innovation and market dynamics could be expected to address interoperability barriers. If those barriers are sufficiently high that there is no realistic prospect of them being circumvented by rivals then a regulator might reasonably opt to capture the static benefits of promoting competition on the basis of common interoperability standards in the expectation that dynamic competition is unlikely to arise spontaneously. Conversely, if there is evidence that rivals might be able to overcome interoperability obstacles then it may be better not to mandate access but to allow firms to compete to find the best means of achieving interoperability. In this regard, while cloud-based solutions increasingly replace workgroup server-based solutions for tasks such as document hosting and sharing, those cloud-based solutions were not yet available at or even near the time the Commission issued its decision in Microsoft I – thus suggesting that barriers to competition may indeed have been very high at the time the Commission issued that decision.

In terms of rivals' attempts to establish interoperability with Microsoft Windows without Microsoft's help, the Commission and complainants cited evidence showing that rivals had failed, after costly reverse engineering efforts, to replicate Microsoft's interoperability information; the Commission also found that successful reverse engineering attempts could in any be undermined by Microsoft simply changing its interoperability information.

During the EC investigation Microsoft sought, unsuccessfully, to cite Samba as evidence that it was unnecessary to provide any interoperability documentation to competitors for them to develop competing products.[4] Several leading industry participants, including IBM, HP, SGI and Quantum had already begun to embrace Samba solutions.[5]

Free-riding behaviour promoted by an interoperability remedy could also be expected to reduce innovation incentives on Microsoft itself. Where absent the remedy Microsoft could expect to capture for itself the benefits of improvements in Windows OS and/or interoperability with work group OS, the Commission remedy would require those benefits to be shared with rivals. This reduces the scope for a competitive advantage to be gained through investment in product development, reducing the incentive to pursue such investments.

This point was recognised by the Commission, which took into account the impact of the remedy on innovation incentives. The Commission sought to balance the potential harmful effect on Microsoft's innovation incentives with potential benefits in respect of rivals' innovation, ultimately emphasising the importance of the latter.[6]

Intellectual property rights v. competition rules. The *Microsoft I* case also raised important, related questions about the extent to which competition rules could be used to override intellectual property rights. Microsoft claimed that it was entitled to refuse access to its interoperability information, as that information was protected by various different intellectual property rights. The Commission acknowledged that competition rules should not normally be used to override the exclusivity created by intellectual property rights, as that would undermine the incentives to innovate those intellectual property rights aimed to create – an objective shared by both intellectual property rights and competition rules. However, citing the *Magill* case, it noted that, in exceptional circumstances, competition rules could be relied upon to mandate access to intellectual property rights. Pursuant to that case law, the Commission was required to show not only that the facility is indispensable and that a refusal to provide rivals access to that facility would eliminate them from the market, but also that the rivals needed access to the intellectual property-protected facility in order to develop new products or services for which there was potential consumer demand.[7] The Commission sought to meet this burden by demonstrating that the workgroup servers Sun sought to introduce were novel.

4 See https://www.samba.org/samba/PFIF/PFIF_history.html
5 See https://www.zdnet.com/article/microsoft-steps-on-sambas-toes-5000122696/
6 See section F, Komninos and Czapracka 'IP rights in the EU Microsoft Saga' in F. Etro and I. Kokkoris (eds), Competition Law and the Enforcement of Article 102, Oxford University Press, 2010.
7 See section E, Komninos and Czapracka 'IP rights in the EU Microsoft Saga' in F. Etro and I. Kokkoris (eds), Competition Law and the Enforcement of Article 102, Oxford University Press, 2010.

Overall, the Commission's "refusal to deal" theory of harm seems reasonably closely aligned with the actual concerns held by Sun and other rivals, insofar as they had asked for – but had been refused – access to this information. Sun and others did not claim that there were other forms of abusive conduct that had enabled Microsoft to leverage its Windows client PC dominance into workgroup server operating systems.

2.2 Remedy

The remedy imposed by the European Commission was the mirror image of the conduct found to be abusive. Having found that competition in the work group server OS market was limited due the difficulties that competitors faced developing products able to successfully interoperate with the near universal Microsoft Windows OS, the Commission's remedy sought to ease that interoperability, and thus could be expected to remove the identified barrier to rivals' ability to compete effectively.

However, like other "access remedies," imposing a duty to deal on Microsoft required the Commission to address several specificities of access, including the beneficiaries, scope, timing, and price of the interoperability information to be provided.

As regards the beneficiaries of access, the Decision sought to force Microsoft to provide the interoperability information to any firm having an interest in developing workgroup server operating systems. Although the case rested on the notion that Microsoft's refusal to supply prevented the emergence of new products – in the form of innovative workgroup server products – the remedy was not limited to firms seeking to introduce such new products.

With respect to the scope of the interoperability information to be provided, Article [] of the Decision required Microsoft to provide the "complete and accurate" specifications for all interoperability protocols relied upon by Microsoft's own workgroup server operating systems.

Determining the price of the interoperability information gave rise to further questions. Interoperability access can provide a basis for rivals to compete only insofar as that access is on economically viable terms. As well as the level of charges set for interoperability access, the ability of rivals to compete will also be affected by the structure of charges. Economic theory states that firms paying fixed access terms will not pass the costs of access on to their own customers; but that access terms that vary with volumes (such as percentage royalties) will affect pricing, and hence firms' ability to compete.

The determination of pricing for products and services that would not ordinarily be supplied via market mechanisms is a difficult area for regulators. This is particularly true in cases involving the supply of services, such as interoperability terms, with effectively zero marginal costs. This is demonstrated in the difficulties faced in setting fair, reasonable and non-discriminatory prices in other regulatory contexts, such as standard essential patents.

The Commission avoided this difficulty in its Microsoft I interoperability remedy by requiring Microsoft to provide interoperability information, but not specifying the terms for such access beyond requiring

that they be "reasonable and non-discriminatory". Microsoft set terms for that access, which then became the subject of further dispute between the parties. In 2008 the Commission imposed a fine of €899 million for non-compliance with the remedy, on the grounds that the access fees set by Microsoft were not reasonable, a position substantively confirmed by the General Court in 2012.

The fact that the question of whether the access terms set by Microsoft were indeed reasonable and therefore compliant with the interoperability remedy was not ultimately resolved until eight years after the original infringement decision, via an appeal to the General Court, might be regarded as a negative reflection on the remedy as originally designed.

In order to oversee the effectiveness of the – technically complex – remedy, the Commission required Microsoft to appoint a monitoring trustee, who was given far-reaching powers to assist the Commission in verifying Microsoft's compliance with the remedies. Having found that the trustee's powers went too far, the General Court annulled the trustee appointment – the silver lining in Microsoft's otherwise unsuccessful appeal against the Commission's Decision.

2.3 Effectiveness of the remedy

The intended purpose of the interoperability remedy was to promote the development of competition in the market for work group server OS. This can be considered both directly, in terms of the development of the market structure; and indirectly, by investigating the extent to which third parties sought to take up the interoperability opportunities provided by the remedy. We review the evidence on these two points in turn.

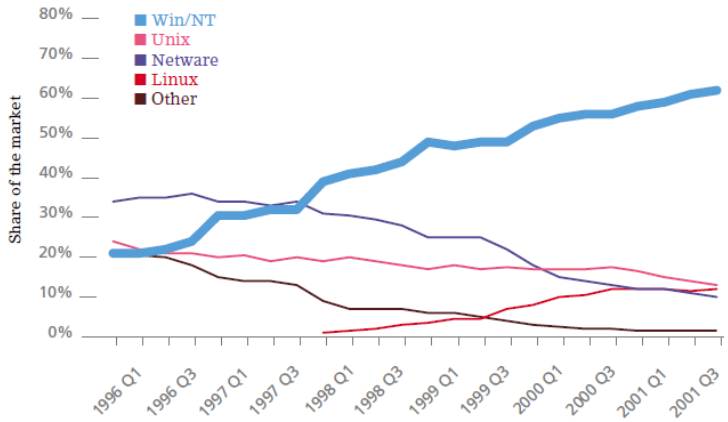
2.3.1 Development of the work group server OS market

There is no clear evidence that the remedy was successful in promoting work group server market competition that challenged Microsoft's position. Far from declining, Microsoft's share in the work group server market increased after the implementation of the remedy.

As illustrated below, in the mid-1990s, Novell's NetWare was the leading work group server OS for file and print sharing, whilst Unix was used for other applications such as databases and email.[8] However, throughout the late 1990s, both NetWare and Unix lost significant market share to Microsoft and later to Linux. In particular, Microsoft's Active Directory was one of Microsoft's most distinctive and innovative server technologies, and was the focus of Sun Microsystems' original demand for what the EC later termed "Interoperability Information".

Figure 1:The growth of Microsoft's share in the work group server OS market 1996Q1-2001Q3

[8] See Page, William Hepburn and Childers, Seldon J. (2008). Bargaining in the Shadow of the European Microsoft Decision: The Microsoft-Samba Protocol License. Northwestern University Law Review Colloquy, Vol. 102, No. p. 332, 2008, Available at https://scholarlycommons.law.northwestern.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1114&context=nulr_online



Source: Figure 1 of "The European Commission versus Microsoft: competition policy in high-tech industries"
http://eprints.lse.ac.uk/4600/1/The_European_Commission_versus_Microsoft_Competition_Policy_in_High-Tech_Industries.pdf

Subsequently, Microsoft continued to expand its share in the work group server OS market. In comments to the European Parliament in March 2007, Commissioner Neelie Kroes noted that when the EC began its antitrust investigation in 1999, Microsoft held between 35% and 40% of market share, rising to around 60% by 2004, and stood at between 70% and 75% in 2007.[9] Similarly, the EC's 2005 and 2008 Decision noted that Microsoft's market share continued to grow following the 2004 infringement Decision.

In the 2004 Decision, one of the market data sources considered by the EC is the IDC Worldwide Quarterly Server Tracker data for a server type segment termed "volume servers" (or "low-end servers" in earlier IDC publications).[10] A 2010 IDC report demonstrates that Windows further bolstered its market position post-remedies, and was expected to largely maintain its position over the coming years, despite strong growth in Linux. As shown in the tables below, as of 2002 Windows had a market revenue share of 60%; by 2009, this had risen to 68%. During this period, various Linux vendors (nearly) doubled their combined share, capturing over a fifth of the market by 2008, whereas Unix and NetWare continued their decline. Novell removed NetWare from its product list in 2011.

[9] See https://www.computerworld.com/article/2544050/eu-official--microsoft-s-behavior--unacceptable-.htm

[10] IDC's server class taxonomy segments the server market into three server classes: the "volume server" segment (consisting of all systems with an average selling value (ASV) below $25,000), the "midrange enterprise server" segment (consisting of all systems with an ASV from $25,000 to $249,999), and the "high-end enterprise server" segment (consisting of all systems with an ASV of $250,000 and above). The EC Decision also noted that a limitation of the IDC data is that there are volume servers that are not work group servers.

Table 1: Worldwide market share by server customer revenue, volume servers only

	2002	2008	2009	2010 (forecast)	2014 (forecast)	2019
Windows	59.7%	66.6%	68.1%	69.1%	67.3%	72.1%
Unix	19.1%	10.6%	9.2%	8.3%	8.2%	5.6%
Linux	10.4%	21.6%	22.0%	21.9%	23.9%	13.6%
NetWare	9.1%	0.8%	0.3%	0.3%	0.1%	
i5/OS		0.1%	0.1%	0.1%	0.2%	
z/OS		0.0%	0.0%	0.0%	0.1%	
Other		0.3%	0.3%	0.3%	0.4%	8.6%

Source: IDC. 2002 data is taken from footnote 606 of the EC 2004 Decision; 2008-2014 data is taken from Table 25 of https://www.novell.com/docrep/documents/ie6so4xkex/Worldwide_and_Regional_Server_2010-2014_Forecast.pdf; 2019 data taken from Statista, https://www.statista.com/statistics/915085/global-server-share-by-os/#:~:text=In%202019%2C%20the%20Windows%20operating,to%20their%20overall%20market%20share.

Notably, from 2002 to 2008, there was a general shift towards Linux which is considerably cheaper and towards richer server configurations, whilst volume servers consistently gained favours over midrange/high-end servers, driving growth in the server market overall.[11]

Microsoft's position has not changed materially in subsequent years, its share remaining above 70% as of 2019.

In the absence of a counterfactual to these developments it is difficult to draw strong conclusions on the impact of the remedy on market structure. It may be the case that Microsoft's position in the work group server OS market would have grown more rapidly absent the remedy. However, the continued expansion of Microsoft in this market, and the modest expansion of rivals would suggest prima facie that the remedy did not have a significant impact in opening the market to competition.

[11] See https://linuxinsider.com/story/windows-bumps-unix-as-server-os-leader-48999.html and https://www.businesswire.com/news/home/20080226006621/en/Worldwide-Server-Market-Experiences-Modest-Growth-in-Fourth-Quarter-as-Market-Revenues-Reach-Seven-Year-High-in-2007-According-to-IDC

2.3.2 Third parties requesting and obtaining interoperability access

Initially, few third parties ultimately pursued interoperability access via the EC remedy. In 2008, the Commission noted that no firm seeking to develop a competing operating system for workgroup servers had yet taken a license under the program; the only licenses taken had been for products that didn't directly compete with Microsoft's server operating system.[12]

During the EC's initial investigation, a number of competitors had been leading proponents of the interoperability remedy, and provided key technical information to the EC. Key competitors included (i) the original complainant Sun, (ii) Novell, (iii) Computer and Communications Information Association (CCIA) representing a number of Microsoft rivals and (iv) Samba.[13]

However, during the appeal process, Microsoft reached private settlements with Sun, Novell and CCIA. In particular, Microsoft's USD 536 million settlement with Novell not only prevented Novell from participating in the EC's investigation and the appeal case, but also meant that Samba's co-author Jeremy Allison, who was employed by Novell at the time, could no longer be directly involved in either case. By the time the Court of First Instance ruled to overturn Microsoft's appeal in September 2007, the only vendor that had been actively advocating for access to Microsoft's Interoperability Information was Samba.

Moreover, in reviewing the royalties Microsoft had charged between June 2006 and October 2007, the EC noted that no competitor of Microsoft in the work group server OS market has entered into a Work Group Server Protocol Program (WSPP) licence agreement in order to develop and bring to market a competing work group server OS product.[14] For instance, in March 2007 Quest Software became the first EU WSPP licensee, with plans to use those protocols to develop software that would expand customers' ability to integrate Unix, Linux and Java authentication systems with Windows servers; however, the European Committee for Interoperable Systems (ECIS), which comprised many Microsoft rivals such as Sun, Red Hat and Oracle, highlighted that the Quest software involved would be built on top of Microsoft's OS and hence further strengthen Microsoft's dominant position, and that Quest as a longstanding Microsoft partner did not make work group servers or any other products that directly compete with Microsoft.[15] [16]

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12 Chapter 7, Gavil, A.I. and H. First, The Microsoft Antitrust Cases: Competition Policy for the Twenty-first Century, MIT Press, 2014.

13 See https://www.samba.org/samba/PFIF/PFIF_history.html; https://www.zdnet.com/article/who-still-cares-about-microsofts-server-communications-protocols/; and https://news.microsoft.com/2004/11/08/novell-and-microsoft-reach-settlement-on-antitrust-claims/

14 See 2008 Decision, footnote 353, https://ec.europa.eu/competition/antitrust/cases/dec_docs/37792/37792_3997_9.pdf

15 See https://news.microsoft.com/2007/03/08/quest-software-and-microsoft-announce-first-license-for-protocol-technology-in-european-licensing-program/; https://www.zdnet.com/article/microsoft-lands-first-licensee-in-eu-protocol-program/; and https://www.nytimes.com/2007/03/08/technology/08iht-msft.4847533.html

16 The U.S. licensing programme also appeared to have achieved a similarly meagre in attracting licensees. In January 2004, 11 firms had signed licenses with Microsoft, and all but one indicated an intention to use only a limited category of protocols – file, terminal or certificate services or media streaming – rather than a wider set of protocols for "general server" tasks that might "interact with the Windows desktop in a variety of ways". Despite enforcement and compliance efforts aimed at attracting more licensees, of the thousands of server application developers, by 2007only 29 have taken royalty licenses for Microsoft's licenses, and 12 have signed royalty-free licenses for published and industry-standard protocols. Using the protocols, these licensees brought a total of 14 products to the market, none of which had any platform potential, let alone potentially compete with Windows as a general-purpose platform. See Page, William & Childers, Seldon. (2007). Software Development as an Antitrust Remedy: Lessons from the Enforcement of the Microsoft Communications Protocol Licensing Requirement. Available at https://repository.law.umich.edu/mttlr/vol14/iss1/3/

The EC seemed to imply that, in line with Samba's view, the main reason that Microsoft's WSPP had failed to attract licensees was that the WSPP licensing terms were unattractive, rather than that the Interoperability Information were *not* necessary for developing competing products. According to Samba, such Interoperability documentation was key to the addition of important features including full support for Microsoft's Active Directory, encrypted files, a better search interface and support for SMB2, a new version of Microsoft's proprietary protocol for file and print sharing called Server Message Block (SMB).[17] Nevertheless, the EC did not venture a clear finding on the reasons for the lack of licences taken, or the effect, if any, of the royalty rates it had approved.[18]

A month after the Court decision in 2007, Microsoft agreed to comply and make work group server Interoperability Information available to third parties at a price deemed reasonable. The most tangible, and perhaps the only, outcome was the WSPP agreement between Microsoft and Samba, brokered by a non-profit organisation called Protocol Freedom Information Foundation (PFIF). In December 2007, PFIF signed an agreement with Microsoft to receive protocol documentation required for full interoperability with Windows work group server products, and to make it available to Free Software projects such as Samba under non-disclosure terms.[19] PFIF paid a one-off fee of EUR 10,000 to Microsoft. Although the documentation itself was to be held in confidence by PFIF and Free Software engineers, the agreement permits (i) publication of source code of the implementation of Windows work group server protocols, as well as (ii) discussion of the protocol information among implementers which would aid technical cooperation among engineers. The agreement, however, does not fully address the concerns that Samba and the wider open source community had over Microsoft's patent claims for these protocols.

In February 2008 Microsoft announced new Interoperability Protocols, which made available all access protocols for high-volume products used by any other Microsoft product. These protocols were made freely available without requiring developers to take a licence. This approach was formalised in a 2009 interoperability undertaking provided to the Commission.

This final step does then appear to have produced greater user of interoperability access by rival developers. As of 2012, Heiner reports that around fifty firms had chosen to enter into protocol license agreements with Microsoft, and Microsoft was aware of about ninety commercial products, from firms including Cisco Systems, Symantec, EMC and McAfee, that implemented Microsoft's protocols.[20]

Consistent with Microsoft's change in attitude toward Samba and more generally interoperability with Linux, Microsoft also entered into technical collaboration and licensing agreements with leading vendors who offer or support Linux, including Attachmate (which recently acquired Novell's Linux business), Red Hat and Citrix. Microsoft's increased compliance with industry standards and standardisation effort can also be seen in its participation in hundreds of standards groups and

17 See https://www.zdnet.com/article/samba-and-microsoft-strike-interoperability-deal/.
18 Chapter 7 of The Microsoft Antitrust Case (2014), p.254
19 See https://www.samba.org/samba/PFIF/ and https://www.samba.org/samba/PFIF/PFIF_history.html
20 Heiner, D. A. (2012). Microsoft: remedial success. Antitrust Law Journal, 78(2), 329-362.

consortia via an internal Corporate Standards Group comprising engineers, standards specialists and lawyers.[21]

In December 2012, Samba announced the release of Samba 4.0, the first compatible Free Software implementation of Microsoft's Active Directory protocols, acknowledging "*help from the official protocol documentation published by Microsoft Corporation"* and surprisingly "*interoperability testing by Microsoft engineers that made [Samba's] implementation interoperable*".[22] The release also won praise from Microsoft, despite the likely erosion of Microsoft's own work group server business.[23]

The picture is therefore mixed on the success of the interoperability remedy. Initially its impact was limited, but there was ultimately some usage of the access remedy once Microsoft relaxed access conditions. The tortuous process towards the implementation of the remedy, which only appears to have reached a form that had the desired impact on the market in 2008, underscores the practical difficulties in designing interoperability and access remedies.

Moreover, even if rivals were eventually granted interoperability access, this has not resulted in any material change in server OS marker structure; Microsoft continues to hold a leading position. Care should be taken in interpreting this as necessarily indicating a failure of the remedy however; if the interoperability access identified as an issue by the Commission is considered to have been addressed by the remedy, then Microsoft's continued success cannot be presumed to indicate some further failure of competition, but may simply reflect competition on the merits within the server OS market.

3 ToH2: tying

In this section we discuss concerns in respect of tying of Microsoft products raised by the Commission in Microsoft I (in respect of WMP) and Microsoft II (in respect of IE).

3.1 Legal and economic concerns

More so than in the interoperability case, the two Microsoft tying cases – WMP (*Microsoft I*) and IE (*Microsoft II*) – demonstrate that economic and legal concerns are not always identical, and that the choice of the legal theory of harm can affect (and limit) the range of available remedies.

The concern in both tying cases related to the potential anticompetitive effect of leveraging market power from the Windows OS into related markets. In Microsoft I, this concern related to tying Windows Media Player to Windows OS; in Microsoft II, the theory of harm related to tying IE to Windows OS. The potential anticompetitive effect of such bundling arises from exclusion of single product rival firms that are not able to compete effectively with the bundle. This situation derives from the low implicit or incremental price of the tied good when combined with the tying good for

[21] Heiner, D. A. (2012). Microsoft: remedial success. Antitrust Law Journal, 78(2), 329-362.
[22] See https://www.samba.org/samba/news/releases/4.0.0.html
[23] Ibid. Thomas Pfenning, director of development for Windows Server , remarked that "*Active Directory is a mainstay of enterprise IT environments, and Microsoft is committed to support for interoperability across platforms. We are pleased that the documentation and interoperability labs that Microsoft has provided have been key in the development of the Samba 4.0 Active Directory functionality.*"

customers that would purchase the latter in any case. By offering WMP and IE at zero marginal cost to customers of its dominant Windows client PC operating system, Microsoft undermined demand for rival media players and browsers, respectively, which – unlike WMP and IE – were generally not pre-installed on Windows PCs.

Closely related was the fact that – by virtue of this pre-installation - both WMP and IE were prominently placed on and readily accessible from the user's Windows desktop. This rendered users – already equipped with a media player and browser – less likely to try out competing media players or browsers, given that finding and downloading such alternative products required efforts from the user. This theory of harm was informed by behavioural economics, which suggests that end user inertia and other biases that prevent consumers from making optimal decisions may facilitate leveraging of market power.[24]

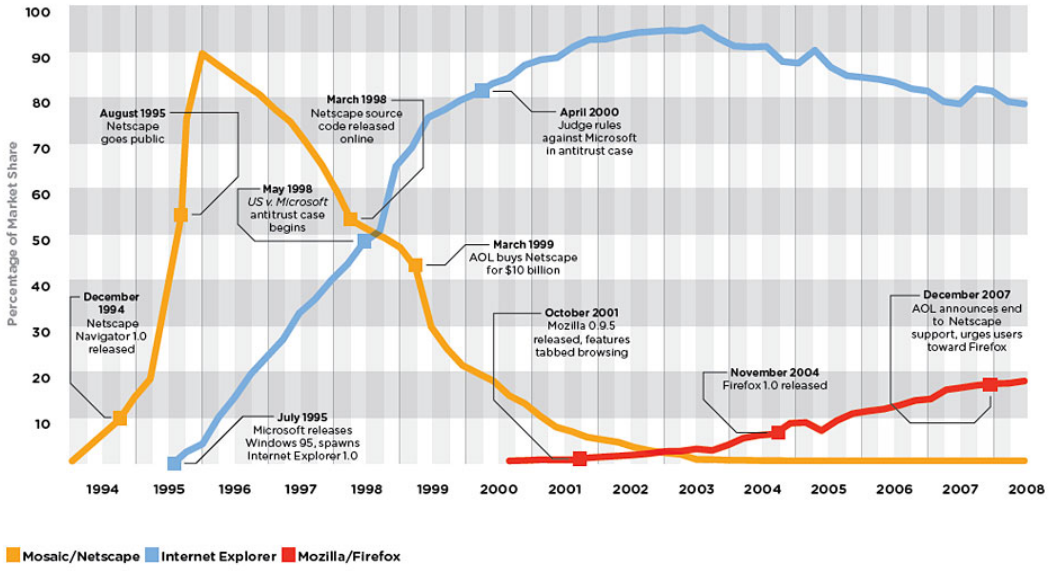
In both cases, the foreclosure effects realized by Microsoft's pre-installation of WMP and IE were exacerbated by network effects and incompatibility. Because content producers knew that WMP was installed on every single Windows PC, whereas rival media players had a far smaller installed base, they had an incentive to provide their content in WMP's proprietary format in order to reach the largest audience. This, in turn, encouraged more use of WMP by consumers, which led to even more content creators providing WMP-compatible content, thus creating a feedback loop benefiting WMP but undermining rival media players. The same applied to IE, which relied on a version of the web's HTML language that was not fully compatible with that used in most rival browsers.

While the WMP case was pursued as a relatively straightforward case of leveraging dominance in one market (Client PC operating systems) into another (media players), the concerns expressed in IE involved not only leveraging, but also monopoly maintenance. In particular, the Commission – mirroring concerns expressed earlier by the U.S. Department of Justice – was concerned that, by foreclosing rival web browsers, Microsoft not only came to dominate the browser market, but could also prevent web browsers from replacing the client PC operating system as the main platform through which users engaged with applications. Indeed applications were increasingly being made available through web pages that could in theory be run in web browsers on any platform, not just Microsoft's Windows. However, as a result of the tie between Windows and IE, web creators tended to optimize their web pages for IE rather than competing web browsers, thus keeping users dependant on Microsoft solutions.

The development of the browser market provides some prima facie support for the Commission's concerns. Internet Explorer expanded rapidly following the mid-1998 introduction of the Windows 98 OS into which it was incorporated. At the start of 1998, two and a half years after its introduction, Internet Explorer's user share was around 40%. The market leader at this point was Netscape Navigator, which held a circa 60% share. By the end of that year, IE had overtaken Navigator, to reach a market share of around 65%.

[24] Petit, Nicolas, and Norman Neyrinck (2011). "Back to Microsoft I and II: Tying and the Art of Secret Magic." Journal of European Competition Law & Practice 2.2, 117-121.

Figure 2:Internet browser shares



Source: Wired.com

https://hsto.org/getpro/habr/post_images/dbe/3a1/8aa/dbe3a18aad1a92aebdb3c423714e8966.jpg

In short, therefore, the economic concern in both the WMP and IE cases was that Microsoft, by pre-installing WMP and IE, removed users' incentive to use media players and browsers competing with WMP and IE, exacerbated by a positive feedback loop as content and web creators adhered to the WMP and IE formats through which they could expected to reach users on the entire Windows installed base.

The legal case may not perfectly have captured these economic concerns. In both cases, the Commission alleged abusive tying by Microsoft. Under established case law, the key elements of a tying case – and thus the key elements on which the WMP and IE cases were based – are (i) the separate nature of the tying and tied products, and, crucially (ii) the fact that consumers of the (dominant) tying product are given no choice but to obtain that product together with the tied product.

Microsoft argued that consumers benefited from being provided with an operating system equipped with a media player and a browser, and that nothing prevented consumers from downloading additional media players or browsers. In the WMP case, the Commission, upheld by the General Court, rejected these arguments, noting that even if consumers might prefer having a media player, they might well prefer to use a different media player than the one pre-installed by Microsoft. They were however unlikely to do so as downloading and installing another media player required a certain degree of technical competence, with little incentive to pursue such alternatives due to the ready availability of WMP. In the IE case, Microsoft relied on similar arguments, and faced a similar response.

It is debatable whether the Commission's choice for a tying theory of harm in the WMP and IE cases aligned with the actual (economic) concerns in both cases. As noted above, the actual concerns were that, as a result of Microsoft's conduct, consumers were incentivized to use Microsoft's media player and browser rather than competing products. However, under the legal theory of harm pursued, the focus was not so much on consumers being incentivized to use Microsoft's products in preference to rivals', but rather that they had no choice but to obtain Windows together with WMP and IE. In other words, the mere re-introduction of that choice (namely, the ability to obtain Windows without WMP or IE if preferred) would remove the legal concern, even if consumers might have no incentive to obtain a version of Windows without WMP or IE.

3.2 Remedy

The Commission's choice of remedy in the WMP case appears to have been driven by the legal nature of the case. WMP was a prohibition decision under Article 7 of Regulation 1/2003 in which the Commission conclusively established an infringement and unilaterally imposed a remedy on Microsoft. This required the Commission to impose a remedy that addressed the legal concern identified by it and was proportionate in relation to those concerns. As noted above, the key legal concern was that Microsoft did not offer customers the choice to obtain its dominant client PC operating system, Windows, without WMP. Thus, the core of the WMP remedy was an obligation on Microsoft to restore customer choice as to obtaining Windows with or without WMP. To that end, the Commission required Microsoft to "*offer a full-functioning version of the Windows Client PC Operating System which does not incorporate Windows Media Player*" adding that "*Microsoft Corporation retains the right to offer a bundle of the Windows Client PC Operating System and Windows Media Player*."

Because the legal concerns did not extend to pricing concerns, Microsoft remained free to charge identical prices for both Windows with WMP and Windows XP N. Similarly, because the prominent placement of WMP was not a core element of the legal case, the Commission did not require Microsoft to change the prominent placement of WMP in the Windows version with WMP; as far as the legal theory of harm was concerned, that theory of harm was fully addressed by Microsoft providing XP N.

From an economic perspective, in order to address a concern that single product media player suppliers could not compete effectively against WMP bundled with Windows, a remedy would ideally break the link between the tying and tied products entirely.

Viewed in this way, it is not clear that the WMP remedy was well targeted at addressing the essential source of competition concerns. While the remedy defined a non-tied product, Windows XP Edition N, it did not set any requirement on the price of that product. The remedy therefore allowed Microsoft to sell Windows XP (with WMP) and XP Edition N (without WMP) at the same price, which was the strategy it indeed chose. In this scenario, the incremental cost to customers of purchasing WMP bundled with the Windows OS was zero. That is, a customer would have to make a specific choice to not receive WMP for no financial benefit. Given that use of WMP was optional for users, and did not preclude any choice to use an alternative media player product instead of or in parallel to WMP, there was no clear incentive for customers to consider not purchasing the tied product. Consequently, any

anticompetitive concern arising from single product rivals facing difficulties in gaining users against WMP would likely remain.

By contrast, IE was a commitment decision under Article 9 of Regulation 1/2003, in which Microsoft proposed a resolution to address the Commission's (by then preliminary) tying concerns, and negotiated that resolution with the Commission. On the one hand, this enabled the Commission to accept and make legally binding remedies that it might not have been able to impose in a prohibition decision; on the other hand, it also enabled Microsoft to propose a resolution that was more in line with its own business interest. Thus, rather than providing a version of Windows without IE, Microsoft offered – and the Commission accepted – a so-called "choice screen", which pro-actively alerted users to the existence of alternative browsers, giving them an opportunity to download and install those alternative browsers. Under the settlement, Microsoft was not required to alter the pre-installation or prominent placement of IE, albeit that the choice screen contained instructions on how to disable IE. The choice screen would be shown twice to users of new Windows PCs during a five-year period.

The IE remedy appears to have been better tailored to meet its objectives than the WMP remedy. Rather than relying on consumers to opt-out of a bundle without any benefit to doing so, the choice screen encouraged consumers to choose one or more of a series of pre-selected alternative browsers. This did not take away the option of users choosing to retain IE, but aimed to disrupt any default bias or inertia that might lead consumers to not consider alternatives by explicitly presenting alternative options.

The advantages of the IE Microsoft II remedy do indeed appear to be borne out in the evidence on market impact presented in the next section. The arguably more effective remedy in this case may have resulted from the Commission's experience of the impact of the Microsoft I WMP remedy, both in terms of specific remedy design, but also procedural approach with respect to the benefits of informal settlement.

Interestingly, Bellis notes that an informal settlement was also explored in the WMP case, Microsoft suggesting that three rival media players be bundled alongside WMP within Windows, allowing consumers to choose a default player.[25] Such an approach has clear parallels with that adopted in the IE case. Bellis explains that this proposal was seriously considered, but a settlement could not ultimately be reached, leaving the Commission feeling it could only address its tying concerns via an untying remedy.[26]

3.3 Potential alternative remedies

The preceding discussion raises the question of how the Commission might alternatively have sought to remedy its tying theories of harm. Insofar as the tying theories of harm fundamentally relate to WMP/IE being provided to customers purchasing Windows OS at no additional cost, the Commission could have considered breaking this tie entirely. This could be achieved by requiring Microsoft to only supply WMP/IE as separate purchases to Windows; or even, taking a step further, by mandating a

[25] Bellis, J.-F. (2015), EU commitment decisions: What makes them so attractive?, Concurrences 3-2015, paragraph 27.
[26] *Ibid.*

divestment of the WMP/IE businesses. This would allow rival media players and browsers supplied by non-OS suppliers to compete on an equal footing with WMP andIE.

However, this approach would potentially create its own consumer detriment, by requiring users to choose and source a media player in order to access media content. At the time of Microsoft I, when online delivery of software was less widespread than today, this could have been a non-trivial barrier to using media content for at least some Windows users. In the case of Microsoft II, separation of OS and web browser would have been an even greater impediment to users, as without a pre-installed browser consumers would be unable to access the internet in order to find and download a browser.[27]

While separation would be problematic from a user perspective, one might expect OEMs to respond to such a remedy by pre-installing media players/browsers on their machines prior to sale to consumers. It is reasonable to believe that OEMs would be sophisticated and informed customers, well placed to make decisions between media players, and therefore not susceptible to default bias of the sort that might lead to consumers not considering alternatives to WMP when already bundled with Windows OS. Moreover, OEMs, unlike consumers, would be able to spread fixed search and installation costs associated with deciding amongst media players and browsers across many machines.

This logic would however then call into question the necessity for intervention against bundling. If media player and browser decisions are made not only by consumers but also by OEMs then arguments about consumer default bias and inertia appear less relevant. In practice, as discussed in the following section, there is evidence in respect of media players that OEMs did indeed circumvent tying of WMP by installing other media players in parallel with WMP.

As an alternative approach, the Commission could have sought to make its media player remedy more effective by mandating a price difference between Windows XP and Windows XP Edition N. This would have addressed a concern that WMP was supplied at too low a price to allow rivals to compete effectively by creating an implicit non-zero price for WMP. (It is not clear that there would be a realistic equivalent approach for Microsoft II due to the necessity in practice of a browser to access alternative browsers. In this context customers wishing to use a browser would be forced to purchase an IE enabled version of Windows and so any issues of default bias and inertia would remain.)

This would have been an unattractive prospect for any regulator however, requiring a determination of the "correct" incremental price to be charged for WMP. Mandating prices is an area that competition enforces sensibly prefer to avoid, given the variety of factors influencing price, the complexity of defining pricing schemes to avoid circumvention, and the ongoing costs of monitoring compliance. Pricing is a particularly complex issue in the context of software products, for which the marginal cost of supply is effectively zero, and in which zero pricing can be considered an efficient market outcome. As noted above in [section 2.3], neither the Commission nor the Courts sought to define a specific price for workgroup server interoperability in Microsoft I.

[27] Petit, Nicolas, and Norman Neyrinck (2011). "Back to Microsoft I and II: Tying and the Art of Secret Magic." Journal of European Competition Law & Practice 2.2, 117-121.

Moreover, a remedy that mandated non-zero pricing for WMP would lessen competitive pressure on suppliers of competing media players, potentially leading to an increase in their prices and/or lessening in their quality. In the short term this regulator mandated lessening of competitive constraints would thus create a consumer detriment. Rival media player manufacturers might seek to argue that a move away from an implicit zero price for WMP would provide incentives for greater innovation. However it is notable that many technology markets characterised by network effects and zero marginal costs have gravitated towards zero (monetary) price/advertising funded business models. Of course, the costs and benefits of these business models have themselves become the focus of extensive debate amongst competition practitioners in recent years.

In summary, therefore, there are clear drawbacks to obvious alternative remedies that might have more directly addressed the economic basis for tying theories of harm. We now turn to an assessment of the performance of the two remedies that the Commission pursued in the Microsoft I and II cases.

3.4 Effectiveness of the remedy

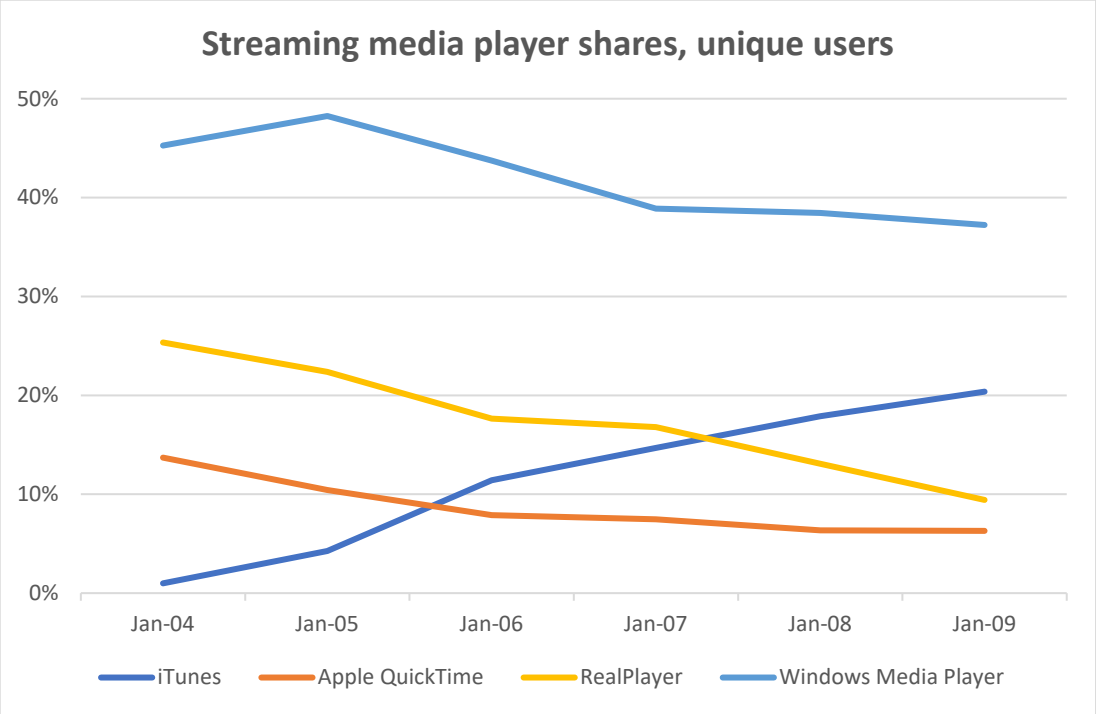
3.4.1 Windows XP N remedy

Windows XP N Edition has become notorious for its lack of commercial impact. According to a Windows XP N Fact Sheet, as of April 2006 there had been negligible demand for Windows XP N from PC manufacturers, retailers and consumers.[28]

- No PC manufacturers had ordered or preinstalled XP N on PCs.
- Only 1,787 copies of XP N had been sold to retailers and distributors in Europe. In contrast, in the same nine-month period, 35.5 million copies of XP were sold in Europe.
- There was no data systematically tracking the number of copies actually purchased by end users, but the French retailer FNAC which had ordered the largest proportion (46%) of XP N copies stated that there was no consumer demand for XP N.

Nonetheless, WMP's market position did decline over time. The following chart shows use of streaming media players in the period preceding and following the introduction of Window's XP N. Nielsen data show that WMP's streaming share of unique users rose from 45% in January 2004 to 48% in January 2005, before declining steadily to 37% by January 2009. This beneficiary of this decline was Apple iTunes, which grew from 1% to 20% of streaming over the same period.

[28] https://regmedia.co.uk/2009/06/12/microsoft_windows_xp_n_fact_sheet.pdf



Source: Nielsen data, accessed at http://www.websiteoptimization.com/bw/0903/#:~:text=Summary%3A%20The%20popularity%20of%20Apple's,remained%20unchanged%20at%2050.7%25%20share

Over time, Microsoft did steadily improve WMP. Format support and Media Transfer Protocol were improved with Windows Vista (released in January 2007).[29] WMP 11 in Windows 7 was however the last substantial makeover where many streaming features were added. Since then, it was clear that WMP, like other Win32 apps, was soon to be phased out. With the introduction of Universal Windows Platform, it seemed that Microsoft had shifted its development efforts to Store apps. In Windows 8, WMP did not receive any upgrades. Instead of WMP, Windows 8 and later versions of Windows used its Store apps Groove Music for audio, and Movies & TV for video. Windows 10 was bundled with these Store apps, and users noticed popup windows recommending a switch from MWP to Movies & TV, advertising greater compatibility with modern formats, 4K support, a mini-player, 360-degree (VR panoramic) videos and better battery life.

Given the lack of take up of Windows XP N, it is difficult to attribute this decline in share and improvements in quality to the Commission remedy. Instead, WMP's market share decline, and potentially also its quality improvements, appear to reflect competition from iTunes, combined with OEMs' choice to install a greater range of media players. PC manufacturers had responded to demand for enhanced multimedia functionality by pre-installing an increasing number of non-Windows media players on PCs. PC manufacturers in Europe an average of 1.4 non-Windows media players in 2004, which by 2006 had more than doubled to an average of 3.2.

[29] https://winaero.com/microsoft-ditching-windows-media-player/

If one takes the view that the minimal sales of Windows XP N Edition imply that the remedy effectively failed to have the intended impact, then the actual market outcomes observed could be considered to represent the counterfactual to that remedy. That is, the above decline of WMP at the expense of iTunes, improvements in WMP, and increased range of OEM media player installations might be considered likely to have arisen absent any intervention against tying in Microsoft I. On this basis the merits of the Commission's tying theory of harm with respect to WMP could perhaps be questioned. While it is difficult to make forecasts in markets as dynamic as the technology and software industry, if rivals were within a relatively short period of time able to find means of competing against WMP notwithstanding the minimal penetration of the unbundled Windows XP N Edition, then the tying conduct would seem not to have in fact represented a significant impediment to rivals' ability to compete effectively. On this basis, the need for intervention against Microsoft's tying strategy may be questioned.

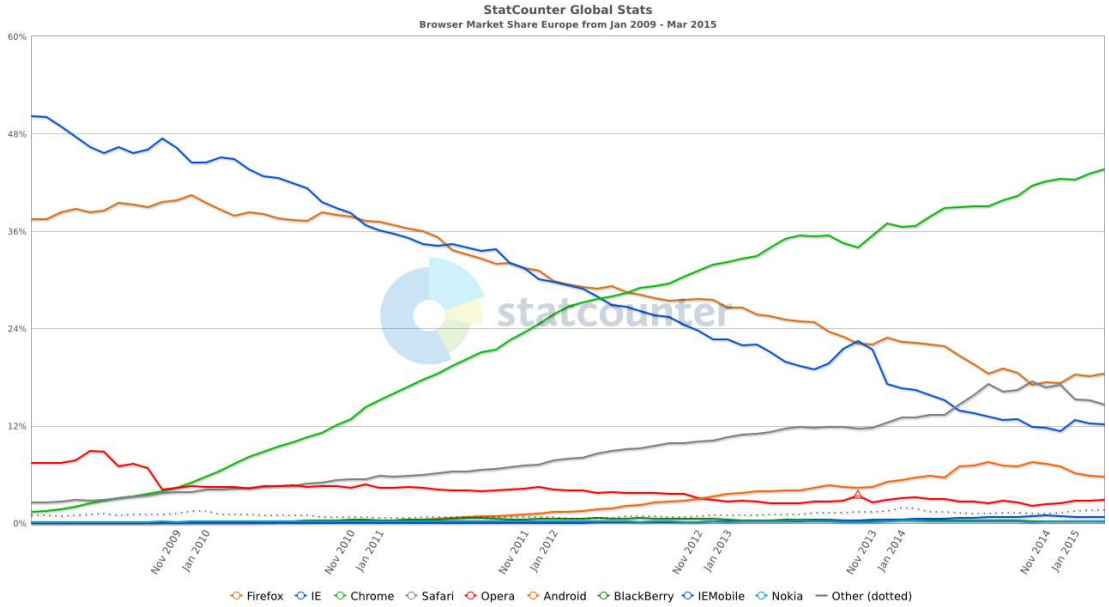
3.4.2 Browser choice screen remedy

3.4.2.1 Impact on market structure

The impact of the browser choice remedy can be assessed via a review of browser shares over time. Browser share data are collated and published by Statcounter Global Stats, which measures shares on the basis of page views. The following chart shows browser shares for Europe over the period January 2009 (the earliest available period) to March 2015, five years after the introduction of the choice screen remedy.

The data show that Internet Explorer's share of browser usage was declining throughout the period from January 2009. The rate of decline from early 2010 does accelerate to some extent. During 2009 Internet Explorer's share of usage declined by 5.8 percentage points, representing an 11% decline in share. During the following three years however it lost an average of 7.3 percentage points of usage share per annum, equivalent to a 20% average annual decline.

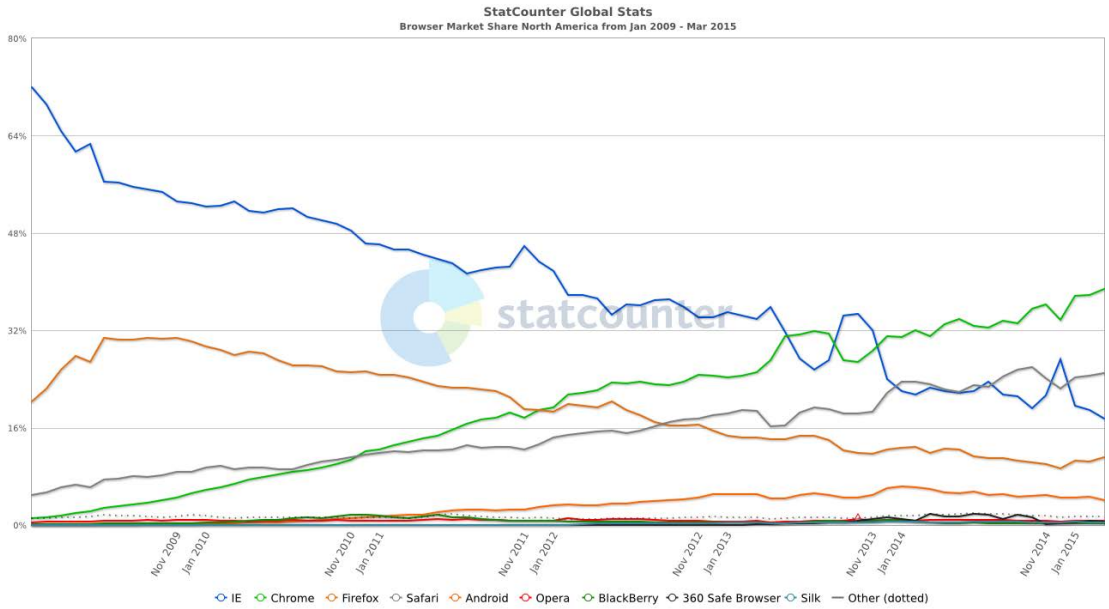
By contrast, Google Chrome, which replaced Internet Explorer as the leading browser in Europe in the first half of 2012, expanded rapidly following the introduction of the choice remedy. In 2009 it gained 4.4 percentage points of usage share. In the following three years, by contrast, it gained an average of 8.8 percentage points per annum.



Source: Statcounter Global Stats.

These data demonstrate that Internet Explorer declined markedly in the period since the introduction of the browser choice screen remedy, and that that decline primarily benefited Google Chrome. These trends may or may not be related to the browser choice screen remedy however. Indeed, the fact that there is no visible impact on market structure of Microsoft's non-compliance over the period May 2011 to July 2012 could be considered prima facie evidence that Internet Explorer's decline was not due to the choice screen remedy.

In order to assess the extent to which this pattern may be related to the remedy, these data can be compared to market developments in the US, where no such remedy was implemented.



Source: Statcounter Global Stats.

Again, there is a pattern of decline for Internet Explorer between 2009 and 2015, and of expansion for Google Chrome. The decline in Internet Explorer's share following March 2010 is much less steep than in Europe however. During 2009 Internet Explorer declined by 19.5 percentage points, equivalent to a 27% reduction in usage share. This rate of decline slowed in the following years however, to an average of 5.8 percentage points, or 13% of usage share, per annum in the following three years.

The data thus show that Internet Explorer's share fell materially faster in Europe in the period following the introduction of the choice screen remedy than in the US during the same period. This is despite Internet Explorer having entered that period in a more rapid state of decline in the US than in Europe.

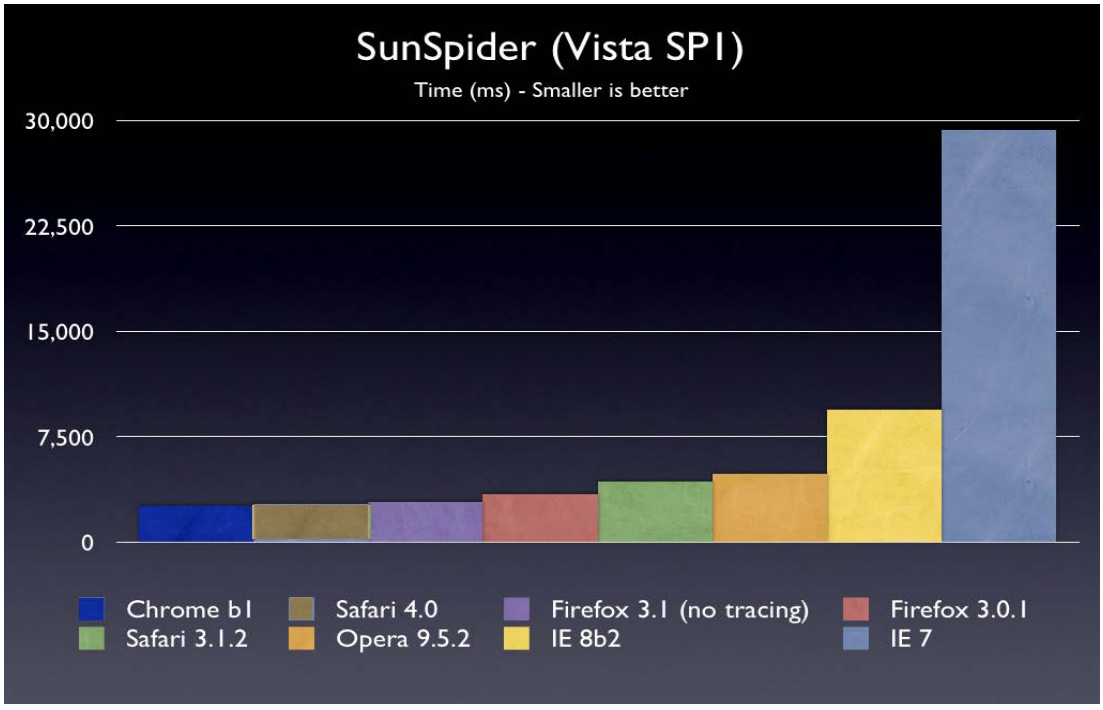
Taken together, this pattern suggests that there was a Europe specific negative impact on Internet Explorer's market position in the period following the introduction of the choice screen. The fact that differing rates of decline are observed in these two regions suggests that market developments in Europe are not due to inherent differences in the relative quality of different browsers. The evidence therefore suggests that the choice screen remedy served the purpose of addressing the Commission's theory of harm that Internet Explorer's position within the browser market may have been boosted by tying to the Windows operating system.

3.4.2.2 Impact on browser quality

The immediate manifestation of the Commission's concern that Internet Explorer may have benefited from being tied to the Windows operating system would be a distortion in the structure of the browser market, with Internet Explorer potentially holding a higher share, and rivals a lower share, of that market than would have been the case absent such tying.

From a competition policy perspective however market structure is a means to an end, and not the end itself. The purpose of a competitive market structure is to promote the process of rivalry that will produce lower prices and higher quality for consumers. It is therefore instructive to consider the evidence on whether the browser choice screen could be considered to have generated greater competition amongst browsers that then led to improved market outcomes for consumers. As browsers are generally provided without monetary charge, improvements would be expected to arise in respect of product quality.

At the time of the *Microsoft II* investigation, IE was widely considered to be inferior to alternative browsers such as Chrome and Firefox. For instance, other browsers were considerably faster in speed. As shown in the figure below, it would take IE 7 significantly longer time to perform Javascript tasks. Some commentators also highlighted that despite IE 7 being better than its predecessor, it was "*still not standards compliant, so designers kept jumping through hoops to have pages render correctly. Not until [IE] 8 landed in 2009 did Microsoft offer a browser that passed standards test Acid2, a widely used measure of how well browsers complied with the standards of the day, and the company lagged in adopting other standards, such as the 3D graphics technology WebGL*."[30]



Source: http://ejohn.org/blog/javascript-performance-rundown

In July 2010 PCWorld from IDG reviewed key features of five leading browsers, including IE8, which was introduced in March 2009.[31] This review found that IE 8 lacked many useful features that were available in other browsers, as set out in the table below.

30 https://www.wired.com/2016/01/the-sorry-legacy-of-microsoft-internet-explorer/
31 https://www.pcworld.com/article/200963/web_browser_reviews.html

Table 2: Comparison of key features of top 5 browsers as of July 2010

Browser	Theme support	Add-on support	Bookmark/ data sync support	Extra security features	Plug-in crash protection	Web page crash protection	RSS reader
IE 8	No	Accelerators, toolbars, Web Slices	None	URL domain highlighting	No	Yes	Yes
Firefox 3.6	Yes	Extensions, toolbars	None	Plug-in update checker	Yes*	No	Yes
Chrome 5	Yes	Extensions	Google Bookmarks syncing	Sandboxing, URL domain highlighting	Yes	Yes	No
Safari 5	No	Extensions	MobileMe Bookmarks syncing	None	Yes	No	Yes
Opera 10.53	Yes	Widgets	Opera Link	None	No	No	Yes

Source: *https://www.pcworld.com/article/200963/web_browser_reviews.html*
Note: **Crash protection introduced with Firefox 3.6.4.*

Moreover, through lab-based tests and subjective examinations, this review found that:

- **Chrome** was the best browser in terms of interface and security, with a characteristically impressive JavaScript handling performance but only a slight edge in page-loading speed; and
- **Firefox** had the best extension support and library.
- **IE** nonetheless showed significant improvement in several areas. For instance,
  - historically IE had performed poorly in terms of security, IE 8 added some "solid security features".
  - although Chrome's had the fastest page-loading time overall, IE was in fact the fastest browser in five out of the eight page-loading tests performed, and the speed differences between Chrome and IE were negligible.

More recently, Tamary and Feitelson (2015) performed a series of technical performance tests on various versions of IE, Chrome and Firefox. The results of these tests are summarised in the table below. Overall, the Tamary and Feitelson results appear to suggest that Chrome has maintained its technical superiority in many aspects over time, but that IE and also Firefox had exhibited clear improvement.

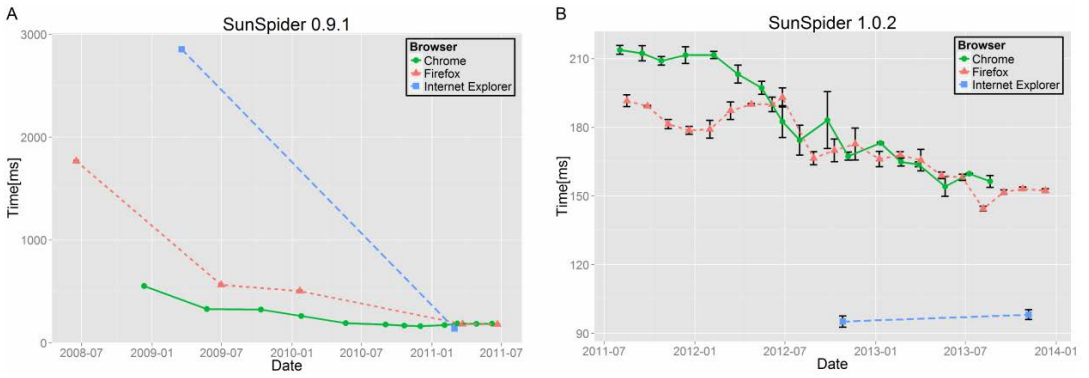
Table 3: Comparison of technical performance and conformance of IE (v8-v11), Chrome (v1-v31) and Firefox (v3-v26)

Type	Benchmark	Content	Response	Result
Performance	SunSpider	Javascript tasks	Time	Chrome was best until 2011, now IE is significantly better
	BrowserMark	General browser performance	Score	Chrome is best, IE worst
	CanvasMark	<canvas> tag	Score	Chrome is relatively good but inconsistent, Firefox worst
	PeaceKeeper	Javascript tasks	Score	Chrome is significantly better
	Start-up times	Cold startup time	Time	initially Chrome was better but now Firefox is better, IE has deteriorated
Conformance to common standards such as HTML5 and CSS3	HTML5 Compliance	HTML standard	Score	Chrome is better, IE worst
	CSS3 Test	CSS standard	Score	Chrome is better
	Browserscope Security	Security-enhancing features	Tests passed	Chrome is better, Firefox worst

Source: Tamary, Jonathan, and Dror G. Feitelson. "The rise of Chrome." PeerJ Computer Science 1 (2015): e28., https://peerj.com/articles/cs-28.pdf

In fact, IE 9, released in March 2011, surpassed Chrome in the SunSpider tests, as illustrated in Figure 3. However, some industry commentators suggested that Microsoft might have specifically optimised JavaScript performance just to boost IE's SunSpider test performance.[32]

Figure 3: SunSpider test results

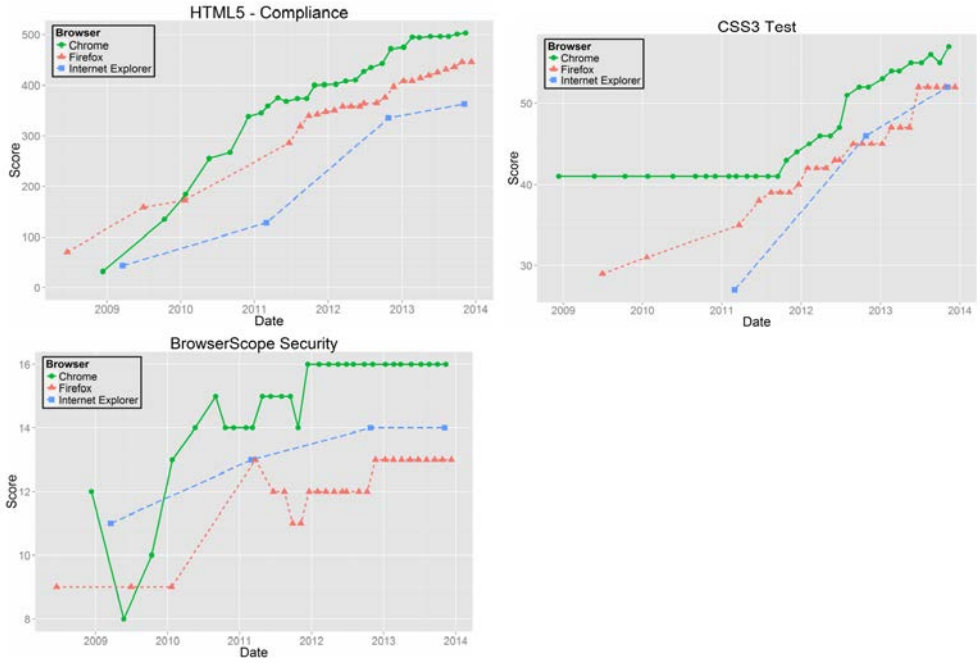


Source: Tamary, Jonathan, and Dror G. Feitelson. "The rise of Chrome." PeerJ Computer Science 1 (2015): e28., https://peerj.com/articles/cs-28.pdf

As regards standard conformance, Tamary and Feitelson (2015) found broadly similar improving trends among the three browsers using three types of tests, as shown in the figure below.

[32] See http://blogs.msdn.com/b/ie/archive/2010/11/17/html5-and-realworld-site-performance-seventh-ie9-platform-preview-available-for-developers.aspx and http://digitizor.com/2010/11/17/internet-explorer-9-caught-cheating-in-sunspiderbenchmark/

Figure 4: Conformance test results



Source: *Tamary, Jonathan, and Dror G. Feitelson. "The rise of Chrome." PeerJ Computer Science 1 (2015): e28., https://peerj.com/articles/cs-28.pdf*

The observed improvements in IE's capabilities could potentially be attributed to greater competition within the browser market spurred by the Commission remedy promoting consumer choice. However, given that browsers are developed at a global, rather than regional level, it is difficult to attribute quality improvements to the Commission remedy specifically. It is possible that greater competitive intensity in Europe encouraged Microsoft to invest in improvements to IE globally; however those quality investments may equally have been driven by IE's (more slowly) declining position within the US.

4 Conclusions

The European Commission's cases against Microsoft have firmly established themselves among the landmark antitrust cases, in particular in relation to antitrust enforcement in the technology sector. However, these cases also highlight some challenges in designing effective remedies.

In the case of WMP, the "untying" of WMP from Windows – while strictly speaking responsive to the legal concerns expressed by the Commission – did not result in an attractive remedy package: very few customers were interested in the XP N version of Windows without WMP, in particular as the price was the same as that for Windows with WMP. These problems precluded a broad uptake of the WMP remedy, meaning that they were arguably never effectively put to the test.

In the workgroup server case, implementation of the remedies – provision of interoperability information to competing workgroup server operating system developers – was similarly plagued by

pricing concerns, which took several years to resolve. However, even after these concerns were resolved and more competitors obtained access to Microsoft's interoperability information, the structure of the workgroup server operating systems market appeared not to be affected.

The remedy used in the Internet Explorer case appeared to have a greater market impact. Europe saw a broader uptake of rival browsers after the implementation of the choice screen, and there is evidence that the EC remedy made a positive contribution to browser competition when compared to the U.S., where there was no such intervention.

The Microsoft cases also demonstrate that the legal and procedural framework underlying the case can significantly affect the remedy. In particular, the European Commission is more constrained in the type of remedy it can impose in a prohibition decision than it is in the case of a settlement (commitment) decision. In the latter case, it is for the company under investigation to propose remedies, and those remedies may include measures the Commission would not have been able to impose unilaterally.

Nevertheless, the relevance of the Microsoft cases goes well beyond (the effectiveness of) their remedies. In particular, these cases not only firmly established the European Commission as a global technology antitrust enforcer, but they also provided an analytical framework – upheld by the EU's General Court – that antitrust practitioners and enforcers can build on. Against a backdrop of increasing scrutiny of digital platforms, the Microsoft cases will continue to be frequently cited.