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Opening the Black Box: Uncovering the European Commission's Cartel Fining Formula Through Computational Analysis

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Abstract. Is the European Commission biased against non-EU and in particular U.S. firms when enforcing competition law? This 'protectionist hypothesis' has been rejected in the area of merger control. In the areas of abuse of dominance and restrictive agreements, however, few researchers have empirically tested the Commission's decisional practice for protectionism. The difficulty is that, despite increased transparency since the 2006 Fining Guidelines, the Commission's fine-setting process remains opaque, which is why it has been likened to a 'black box'. This article opens that black box by computationally assessing all cartel fines based on the Fining Guidelines from 2006 until 2020. For the tenures of Commissioners Almunia and Vestager, and for some steps of the fine calculation, we find a fining methodology so consistent it can be considered a 'fining formula'. This formula shows no clear evidence of the protectionist hypothesis.

I. Introduction: The Commission's Fine-Setting Process and the Protectionist Hypothesis

Where do these 'magical numbers' come from? A judge in the General Court (GC) put this question to the European Commission (EC) when the cartelists in the *Graphite Carbon* case appealed the calculation of their 100M EUR fine.[1] The GC ended up confirming the EC's decision, including the fine,[2] but the question goes to a more fundamental point, namely that the EC's fine-setting methodology can be opaque.

In recent years, significant strides have been made in increasing the transparency of the fine-setting process. Most importantly, the EC's latest 'Guidelines on the method of setting fines' (hereafter: 'Fining Guidelines')—adopted in 2006 and aimed explicitly at 'ensur[ing] the transparency and impartiality of its decisions'—describe a clear methodology.[3] The EC proceeds via a two-step process. Firstly, it determines the 'basic amount' of the fine by taking a proportion of the value of sales to which the infringement relates, multiplying it by the years of infringement, and adding an additional amount. This additional amount, which is irrespective of the cartel's duration, penalizes the mere entry into a cartel (the so-called 'entry fee'). Secondly, it adjusts the basic amount by taking into account aggravating and mitigating circumstances and then adding a specific increase for deterrence. Beyond a step-by-step methodology, the Fining Guidelines also provide lower and upper limits for certain intermediate steps (in the first step, for example, 0–30% of the value of sales is taken into account depending on the gravity of the infringement) and indications as to what infringers may expect *within* those limits (for hardcore restrictions such as horizontal price fixing, for example, 'the proportion of the value of sales taken into account … will generally be set at the higher end of the scale').[4]

More schematically, the Fining Guidelines thus describe a fine-setting process with the following steps and limits:

1. **first, calculate a basic amount by:**
   a. taking 0–30% of the value of sales to which infringement relates in the last full business year of participation ('base amount'); and

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[1] As reported in Patrick Van Cayseele, Peter Camesasca and Kristian Hugmark, *The EC Commission's 2006 Fine Guidelines Reviewed From an Economic Perspective: Risking Overdeterrence*, 53 ANTITRUST BULL. 1083, 1090 (2008), referencing *EC Defends "Exorbitant" Base Amount Fines in Graphite Carbon Cartel*, Mlex (2008).

[2] *See* Case T-68/04, SGL Carbon AG v. Comm'n, 2008, ECLI:EU:T:2008:414 (Oct. 8, 2008).

[3] Eur. Comm'n, Guidelines on the Method of Setting Fines Imposed Pursuant to Article 23(2)(a) of Regulation No 1/2003, 2006 O.J. C210/2 (hereafter: 'Fining Guidelines').

[4] *Id.* paras 21–23.

    b. multiplying it by the number of years of participation in the infringement;[5] and

    c. adding 15-25% of the value of sales to which the infringement relates ('additional amount' or 'entry fee');[6]

2. then, adjust the basic amount by:

    a. increasing it in case of aggravating circumstances or decreasing it in case of mitigating circumstances;[7] and

    b. adding a specific increase for deterrence.[8]

The final amount of the fine cannot exceed 10% of the undertaking's total turnover in the preceding business year.

The Fining Guidelines were rightly hailed as a step forward in terms of transparency.[9] Despite the guidelines' clear process, however, the EC retains a significant margin of discretion when setting fines. Firstly, it reserves the right to deviate from the methodology and limits when necessary,[10] although most deviations so far relate to how relevant sales are calculated.[11] Secondly, *within* the limits set for itself, which often result in a fairly large 'fork', the EC remains free to decide a specific (percentage-wise) amount. Of course, the EC is limited to some extent by the GC, which reviews fines with 'unlimited jurisdiction', meaning it can cancel, reduce or increase the fine. Even though it does not always fully exercise that jurisdiction,[12] it finds fault with EC fines often enough.[13]

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[5] The EC does not only account for full years but also fractions of years (initially half years but smaller fractions later on, *see infra*, Section II).

[6] The entry fee is targeted at hardcore restrictions, although the EC 'may' also apply such an additional amount in case of other infringements. *See*, *id*. para 25.

[7] Aggravating circumstances include recidivism, refusal to cooperate, and cartel leadership. The Fining Guidelines only set a limit to the increase for recidivism (up to 100%). *See*, *id*. para 28. Mitigating circumstances include negligence, substantially limited involvement, cooperation outside of the Leniency Notice, and encouragement by public authorities. The Fining Guidelines set no limit for the decrease. *See*, *id*. para 29.

[8] The increase for deterrence is called for when undertakings have a particularly large turnover beyond the value of sales to which the infringement relates, and when the amount of gains improperly made as a result of the infringement exceed the fine. The Fining Guidelines et no limit for the increase. *See*, *id*. para 31.

[9] *See* Sven Völcker, *Rough Justice? An Analysis of the European Commission's New Fining Guidelines*, 44 COMMON MARKET L. REV. 1285 (2007) and Wouter Wils, *The European Commission's 2006 Guidelines on Antitrust Fines: A Legal and Economic Analysis*, 30 WORLD COMPETITION 197 (2007).

[10] Fining Guidelines, *supra* note 3, para 37.

[11] In particular when there are no traditional 'sales', *see* for example Comm'n Decision AT.39914, Euro Interest Rate Derivatives, para 639: 'Given that interest rate derivatives do not generate any sales in the usual sense, the Commission applies in the present case a specific proxy for the value of sales'.

[12] Hans Gilliams, *Proportionality of Fines for Infringements of Competition Law*, *in* MUNDI ET EUROPAE CIVIS: LIBER AMICORUM JACQUES STEENBERGEN (Dirk Arts, Wouter Devroe, and Rene Foqué, eds, Larcier 2014) 436-38.

[13] Dieter Paemen and Jonathan Blondeel, *Appealing EU Cartel Decisions before the European Courts: Winning (and Losing) Arguments*, 18 BUSINESS LAW INT'L. 155, 156 (2017) ('about one-third of applicants

To introduce an illustrative judgment that we return to later, consider the case *Infineon Technologies*, which concerned a smart chips cartel with four participants. On 8 July 2020, the GC reduced Infineon's fine for participating in that cartel by almost 6M EUR.[14] When setting the fine, the EC had relied on one unproven anticompetitive contact (of eleven in total) and inadequately took the *relatively* limited number of contacts into account (eleven v. 30+ of two other cartelists).[15] Therefore, the GC considered the 20% fine reduction for mitigating circumstances insufficient and increased it to 25%. To determine the legality of the fine, the GC did not examine the fine's amount *in the abstract* but rather assessed its 'equal treatment' and 'proportionality' through comparison with the other cartelists' fines. At other times, the GC has checked individual fines against the EC's duty to state reasons, specifying its 'obligation to state reasons which enables the person concerned to ascertain the reasons for the measure adopted and the Court to exercise its review.'[16] Both of these legality checks are *internal* to the fining decision.

What about *external* arguments, in particular regarding the consistency of fines imposed for similar infringements over time? For example, the EC applied a 16% base amount in the *Braking Systems* case[17] and a 17% base amount in the first *Occupant Safety Systems* case.[18] Despite the different percentages, the EC explained in both decisions that 'the amount should be set at the higher end of the scale' considering 'the infringement covered the entire EEA' and the conduct was by its very nature 'among the most harmful restrictions to competition'.[19] The decisions were taken only months apart (22 November 2017 and 21 February 2018), and the infringement took place in the same sector, i.e., 'manufacturing of other parts and accessories of motor vehicles' (code C.29.32). To EC outsiders, the 6% increase from one case to the other is thus difficult to explain.

In sum, while fines are given within a transparent framework, the EC retains significant discretion in applying that framework[20]—and it is not always as clear how it uses that discretion, neither internally (in a specific decision, by stating reasons and keeping fines consistent between cartelists), nor externally (keeping fines consistent

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before the General Court achieve some reduction of the amount of the fine imposed by the Commission').

[14] Case T-758/14, Infineon Tech. v. Comm'n, 2020, ECLI:EU:T:2020:307 (July 8, 2020).

[15] *Id*. paras 124 and 192-93.

[16] Case T-199/08, Ziegler SA v. Comm'n, 2011, ECLI:EU:T:2011:285, para 92 (June 16, 2011).

[17] Comm'n Decision AT.39920, Braking Systems, para 102.

[18] Comm'n Decision AT.39881, Occupant Safety Systems Supplied to Japanese Car Manufacturers, para 119.

[19] Comm'n Decision AT.39920, Braking Systems, paras 100-01; Comm'n Decision AT.39881, Occupant Safety Systems Supplied to Japanese Car Manufacturers, paras 117-18.

[20] See figure 2 for the fining formula according to the EC's framework.

between different decisions). It is, therefore, difficult to judge the proportionality of fines when the specific quantification is not fully understood. Some even refer to a 'black box' problem, given that we know the inputs to a fining calculation but cannot observe the process that leads to the result, i.e., the fine.[21] Indeed, one of the most difficult questions an antitrust lawyer may be asked is 'what is this cartel going to cost me?'.[22] Of course, this may not be an altogether bad thing: if fines were fully predictable, we may see more strategic behaviour (i.e., colluding when it is 'worth' the fine).[23]

There is an additional downside to the relative opacity of the fine-setting process: it is the source of geopolitical backlash. The three administrations preceding President Biden (Bush, Obama and Trump) have all accused the EC of using competition law, and fines in particular, to further a (hidden) political agenda.[24] This 'protectionist hypothesis', which holds that the EC is biased against non-EU and, in particular, U.S. firms, first surged after the EC blocked the *GE/Honeywell* merger in 2001.[25] The same accusation of bias surfaced most recently when the EC fined Google

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[21] Floris ten Have, *Call of duty: Commission must state reasons when straying from its guidelines*, STIBBE, Aug. 1, 2019, https://www.stibbe.com/en/news/2019/august/call-of-duty-commission-must-state-reasons-when-straying-from-its-guidelines ('deterrence of cartel behaviour does not justify keeping the methodology for setting the fines as a "black box"').

[22] After that cartel has ended, of course; otherwise, the lawyer's difficulty would be one of ethics—not of mathematics. From conversations with practising lawyers, we learned that some law firms have fining tools to give clients an estimate of the expected fine, but none with particular accuracy. Firms then use these estimates to book provisions.

[23] Economic literature on setting 'optimal fines' often assumes firms will adopt such strategic behaviour, *see*, *e.g.*, Vasiligi Bagari and Yannis Katsoulacos, *A Simple Quantitative Methodology for the Setting of "Optimal Fines" by Antitrust and Regulatory Authorities*, 10 EUR. COMPETITION J. 253 (2014); Patrick Van Cayseele, Peter Camesasca and Kristian Hugmark, *The EC Commission's 2006 Fine Guidelines Reviewed From an Economic Perspective: Risking Overdeterrence*, 53 ANTITRUST BULL. 1083 (2008).

[24] Kiran Stacy, Rochelle Toplensky and Demetri Sevastopulo, *Donald Trump attacks EU action against US tech groups*, FIN. TIMES, June 27, 2019, https://www.ft.com/content/3eb00398-9815-11e9-8cfb-30c211dcd229; Murad Ahmed, Duncan Robinson and Richard Waters, *Obama attacks Europe over technology protectionism*, FIN. TIMES, Feb. 17, 2015, https://www.ft.com/content/41d968d6-b5d2-11e4-b58d-00144feab7de; the Bush administration's criticism was less direct, *see* Department of Justice, *Assistant Attorney General for Antitrust, Thomas O. Barnett, Issues Statement on European Microsoft Decision*, Sept. 17, 2007, https://www.justice.gov/archive/atr/public/press_releases/2007/226070.htm, and the EU response described in *EU Official Criticizes U.S. Justice Dept on Microsoft*, CNBC, Sept. 19, 2007, https://www.cnbc.com/2007/09/19/eu-official-criticizes-us-justice-dept-on-microsoft.html.

[25] Comm'n Decision COMP/M.2220, General Electric/Honeywell; George Priest and Franco Romani, *The GE/Honeywell Precedent*, WALL ST. J., June 20, 2021, https://www.wsj.com/articles/SB992994589433979465; Philipp Schumacher, *The EU's Flawed Assessment of Horizontal Aspects in GE/Honeywell: Re-visiting the Last Pillar of the European Prohibition Decision* 35 EUR. J. L. & ECON. 211 (2013); Eleanor Morgan and Steven McGuire, *Transatlantic Divergence: GE–Honeywell and the EU's Merger Policy* 11 J. EUR. PUB. POL'Y 39 (2004); Nihat Aktas, Eric de Bodt, Marieke Delanghe and Richard Roll, *Market Reactions to European Merger Regulation: A Reexamination of the Protectionism Hypothesis* (2012) Working Paper, available at https://ssrn.com/abstract=1961188.

around $5B in its *Google Android* decision—the highest antitrust fine ever.[26] The sentiment is understandable, given that Google is also the subject of the second and third highest antitrust fines,[27] while U.S. chip makers Intel and Qualcomm round(ed) out the top five.[28]

At least in the area of merger control, where accusations of bias have found fertile ground, the protectionist hypothesis has been tested and now seems firmly debunked. The more binary nature of merger decisions—either blocking or allowing the merger (with commitments)—facilitates the assessment of whether the parties' nationality influenced the decision's outcome. A convincing majority of studies did not show any bias in the EC's track record.[29] Özden (2005/6), who only looked at the last five years of the 1990s, did find some bias.[30] This divergence might be explained by the finding of Aktas *et al* (2007 and 2012), who concluded nationality did play a role in the past (before around 2000), but not in more recent years.[31] Recent enforcement action, in particular, the EC's blocking of the *Siemens/Alstom* merger, which was meant to create a 'European champion', anecdotally supports the view that the EC does not play favourites—even when powerful Member States (in this case, Germany and France) insist on it.[32] The protectionist hypothesis has thus been rejected in the area of merger control.

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[26] Comm'n Decision AT.40099, Google Android (€4.34B fine). *See*, *e.g.*, former President Trump's tweet: 'I told you so! The European Union just slapped a Five Billion Dollar fine on one of our great companies, Google. They truly have taken advantage of the U.S., but not for long!', https://twitter.com/realDonaldTrump/status/1019932691339399168.

[27] Comm'n Decision AT.39740, Google Search (Shopping) (€2.42B fine); Comm'n Decision AT.40411, Google Search (AdSense) (€1.49B fine).

[28] Comm'n Decision COMP/C-3/37.990, Intel (€1.06B fine); Comm'n Decision AT.40220 Qualcomm (Exclusivity Payments) (€997M fine). Note that both fines were overturned on appeal, *see* Case T-286/09, RENV Intel v. Comm'n, 2022, ECLI:EU:T:2022:19 (Jan. 26, 2022) and Case T-235/18, Qualcomm v. Comm'n, 2022, ECLI:EU:T:2022:358 (June 15, 2022).

[29] Anu Bradford, Robert Jackson and Jonathon Zytnick, *Is E.U. Merger Control Used for Protectionism? An Empirical Analysis* 15 J. EMPIRICAL LEGAL STUD. 165 (2018) (a study that distinguishes itself based on its large dataset, which consists of the 5000 transactions notified to the EC between 1990 and 2014); Mats Bergman, Maria Jakobsson and Carlos Razo, *An Econometric Analysis of the European Commission's Merger Decisions* 23 INT'L J. INDUS. ORG. 717 (2005); Alistair Lindsay, Emanuela Lecchi and Geoffrey Williams, *Econometrics Study into European Commission Merger Decisions since 2000* 24 EUR. COMPETITION L. REV. 673 (2003).

[30] Çaglar Özden, *International Dimensions of Competition Policies: European Responses to American Mergers* 56 REVUE ECONOMIQUE 1413 (2005/6).

[31] Nihat Aktas, Eric de Bodt, Marieke Delanghe and Richard Roll, *Market Reactions to European Merger Regulation: A Reexamination of the Protectionism Hypothesis* (2012) Working Paper, available at https://ssrn.com/abstract=1961188; Nihat Aktas, Eric de Bodt and Richard Roll, *Is European M&A Regulation Protectionist?* 117 ECONOMIC J. 1096 (2017).

[32] Comm'n Decision COMP/M.8677, Siemens/Alstom. According to reports, a more complex picture emerges from Comm'n Decision COMP/M.9014, PKN Orlen/Grupa Lotos, *see* Thibault Larger, *Polish energy deal signals a more political Vestager,* POLITICO, Sept. 28, 2020, https://www.politico.eu/article/poland-energy-deal-pkn-orlen-lotos-margrethe-vestager/.

By contrast, few researchers have studied the protectionist hypothesis in the other areas of competition law, namely restrictive agreements and abuse of dominance. This is not surprising since proving (the absence of) a bias variable's influence on a continuous figure—the fine—cannot make use of the same clear-cut statistical (logistic) regression. Whether a U.S. party received a fine a few millions (or even billions) higher might be attributed to a variety of reasons. For example, Auer and Manne (2019) suggest that the high fines on Google and other U.S. companies are explained by the EC's focus on the tech sector—and (large) tech companies happen to be mostly U.S.-based.[33] Wessely (2019) also supports this view.[34] Bradford (2020) concludes that 'the EU is a tough competition regulator—but it is tough on everyone: U.S. firms, EU firms, and the firms from the rest of the world.'[35]

Cremieux and Snyder (2016) did find a way to largely steer clear of factors confounding the analysis of fines.[36] Using a Bayesian method, they were able to assess if different enforcement agencies were more likely to pursue cases against foreign cartel parties and even whether the fines imposed were likely to be disproportionate. Their crucial insight was that cartels are often pursued in multiple jurisdictions: both cartelists' home country and foreign territory. Consequently, they concluded that the EC does not target foreign companies more frequently or more severely since the cases dealt with are likely to have a parallel home jurisdiction's response.[37]

Even if the EC seems *prima facie* absolved from the protectionist allegation, there would be no ground to accuse the EC in the first place if we knew the exact process behind every fine. If we knew precisely which circumstances played into a fine, we could simply check for nationality variables or determine whether the EC deviated from its standard method in specific cases. Until now, the existence of a truly consistent approach—a fining formula—was unknown.[38] By 'formula' we mean something more determined than what the EC put forward in the Fining Guidelines. A formula would not just have intermediate steps, upper and lower limits (e.g., 0–30%) for each step, and an indication of what infringers may expect within those

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[33] Dirk Auer and Geoffrey Manne, *Is European Competition Law Protectionist? Unpacking the Commission's Unflattering Track Record* (March 25, 2019) ICLE ISSUE BRIEF.

[34] Rainer Wessely, *Anti-American Bias? Or Sound European Competition Law Enforcement?* 34 ANTITRUST 90 (2019).

[35] Anu Bradford, THE BRUSSELS EFFECT: HOW THE EUROPEAN UNION RULES THE WORLD 105 (OUP 2020).

[36] Pierre Cremieux and Edward Snyder, *Enforcement of Anticollusion Laws against Domestic and Foreign Firms*, 59 J. OF L. & ECON. 775 (2016).

[37] Moreover, they suggest it is the U.S. Department of Justice that is biased against foreign entities, see *id.* 797.

[38] Suggesting its existence, *see* Thibault Larger, *An alchemist's guide to concocting an EU antitrust fine*, POLITICO, June 6, 2018, https://www.politico.eu/article/a-beginners-guide-to-calculating-a-competition-fine/ ('it all starts with a rigorous mathematical formula').

limits; it would specifically determine the (percentage-based) amount for each intermediate step and thus the final fine. As such, it would allow for the prediction of cartel fines.[39]

The absence of full transparency has not prevented scholars from reviewing the EC's use of its fining discretion. In line with the EC,[40] their main concern has been the deterrent effect of fining policy: are antitrust infringements effectively discouraged by enforcement? Optimal antitrust fines theory assumes undertakings will infringe as long as profits (overcharges) are higher than any penalty times the probability of getting caught.[41] Logically, the EC should set fines at cartel profits made times the inverse probability of getting caught in order to deter infringements.[42] However, both the EC and its critics face the same constraint in applying this theory: there is no good estimate of the probability of getting caught.[43] In addition, there is difficulty in determining what the precise cartel overcharge is.[44] Recent research puts the median overcharge at 20%.[45] Depending on the estimates used, authors have claimed the EC's fines under- or overdeter.[46] Based on the same framework, scholars have addressed

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[39] At least if the intermediate steps are accurate, *see further* under II. Methodology.

[40] Fining Guidelines, *supra* note 3, para 4: 'Fines should have a sufficiently deterrent effect, not only in order to sanction the undertakings concerned (specific deterrence) but also in order to deter other undertakings from engaging in, or continuing, behaviour that is contrary to Articles 81 and 82 of the EC Treaty (general deterrence).'

[41] Vasiligi Bagari and Yannis Katsoulacos, *A Simple Quantitative Methodology for the Setting of "Optimal Fines" by Antitrust and Regulatory Authorities,* 10 EUR. COMPETITION J. 253 (2014); Patrick Van Cayseele, Peter Camesasca and Kristian Hugmark, *The EC Commission's 2006 Fine Guidelines Reviewed From an Economic Perspective: Risking Overdeterrence,* 53 ANTITRUST BULL. 1083 (2008); Enrico Camilli, *Optimal Fines in Cartel Cases and the Actual EC Fining Policy,* 29 WORLD COMPETITION 575 (2006).

[42] If deterrence is indeed the goal; it would also be possible to base cartel fines on the harm inflicted.

[43] Marie-Laure Allain, Marcel Boyer, Rachidi Kotchoni and Jean-Pierre Ponssard, *Are Cartel Fines Optimal? Theory and Evidence from the European Union,* 42 INT. REV. L. & ECON. 38 (2015); *see also* Cento Veljanovski, *Cartel Fines in Europe: Law, Practice and Deterrence,* 29 WORLD COMPETITION 1 (2007). Some estimates do exist, *see, e.g.,* Peter Ormosi, *A Tip of the Iceberg? The Probability of Catching Cartels,* 29 J. APPLIED ECONOMETRICS 549 (2014).

[44] For estimates, *see, e.g.,* Renato Nunes de Lima Seixas and Claudio Ribeiro de Lucinda, *Computing Cartel Overcharge: When Theory Meets Practice,* 49 ESTUDOS ECONÒMICÒS––INSTITUTO DE PESQUISAS ECONÒMICAS 569 (2019); Yannis Katsoulacos and David Ulph, *Antitrust Penalties and the Implications of Empirical Evidence on Cartel Overcharges,* 123 ECON. J. 558 (2013).

[45] John Connor and Robert Lande, *The Prevalence and Injuriousness of Cartels Worldwide, in* RESEARCH HANDBOOK ON CARTELS (Peter Whelan ed., Edward Elgar 2023). This number is in line with Oxera et al., Quantifying Antitrust Damages: Towards Non-binding Guidance for Courts (Study prepared for the Eur. Comm'n).

[46] Marie-Laure Allain, Marcel Boyer, Rachidi Kotchoni and Jean-Pierre Ponssard, *Are Cartel Fines Optimal? Theory and Evidence from the European Union,* 42 INT'L REV. L. & ECON. 38 (2015); Emmanuel Combe and Constance Monnier, *Fines Against Hard Core Cartels in Europe: The Myth of Overenforcement,* 56 ANTITRUST BULL. 235 (2011); Cento Veljanovski, *Deterrence, Recidivism, and European Cartel Fines,* 7 J. COMPETITION L. & ECON. 871 (2011); Patrick Van Cayseele, Peter Camesasca and Kristian Hugmark, *The EC Commission's 2006 Fine Guidelines Reviewed From an Economic Perspective: Risking Overdeterrence,* 53 ANTITRUST BULL. 1083 (2008).

the fines' proportionality.[47] The few attempts at uncovering the EC's method also mostly test factors relevant according to this theory.[48] Although these experiments have not successfully determined the EC's fining formula, they were a first step in working out whether such a consistent approach even exists.

This article is the first to prove that there is a formula-like approach for the EC's cartel fines. We even go one step further and reverse engineer what exactly this formula is.

II. Methodology: Computational and Doctrinal

Firstly, let us clarify the scope of our research. Our study is limited to *cartel* decisions as registered in the EC database.[49] Given the quantitative nature of our research, we wanted to include as many fining decisions as possible, which is why we searched for both prohibition and settlement decisions in the policy area 'cartels'.[50] We did so for decision dates in the range 01.01.2006 until 31.12.2020.[51] Then, we manually removed those decisions that were not yet based on the 2006 Fining Guidelines, which only apply in cases where a Statement of Objections is notified after the Guidelines' date of publication in the Official Journal (01.09.2006).[52] The final dataset contains 54 fining decisions. Given that a cartel necessarily involves two parties and often more, those 54 decisions contain 492 separate fines (see annex 1).[53]

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[47] Pieter Huizing, *Proportionality of Fines in the Context of Global Cartel Enforcement* 43 WORLD COMPETITION 61 (2020); *see also* Hans Gilliams, *Proportionality of EU Competition Fines: Proposal for a Principled Discussion*, 37 WORLD COMPETITION 435 (2014).

[48] John Connor and Douglas Miller, *Determinants of EC Antitrust Fines for Members of Global Cartels*, Working Paper (2013); Damien Geradin and David Henry, *The EC Fining Policy for Violations of Competition Law: An Empirical Review of the Commission Decisional Practice and the Community Courts Judgements*, 1 EUR. COMPETITION J. 401 (2005).

[49] Eur. Comm'n, Competition Policy Database, https://ec.europa.eu/competition/elojade/isef/index.cfm. The Eur. Comm'n website defines a cartel as 'a group of independent companies which join together to fix prices, to limit production or to share markets or customers between them', *see* Eur. Comm'n, Antitrust, https://competition-policy.ec.europa.eu/antitrust_en. While not explicitly mentioned in this definition, the policy area is limited to *horizontal* agreements, *i.e.*, agreements between competitors.

[50] A search for 'summary decisions' in the database captures both prohibition and settlement decisions and has the added benefit of also capturing cases where the final decision is not yet published (in that case, we relied on the fining information given in the summary decision, which was complete enough for our purposes).

[51] Comm'n Decision AT.40410, Ethylene is not part of our dataset despite a *decision* date in 2020 because the summary decision was only published in 2021 (C24/14).

[52] *See* Fining Guidelines, *supra* note 3, para 38. Before the Fining Guidelines, the Eur. Comm'n calculated its fines in line with Eur. Comm'n, Guidelines on the Method of Setting Fines Imposed Pursuant to Article 15(2) of Regulation No 17, 1998 O.J. (C9/3). The two Guidelines differ significantly.

[53] Annex available at Bruno Van den Bosch, DG COMP Fining Practices, https://github.com/Bruno-Van-den-Bosch/research-DG-COMP-fining-practices.

From this set of decisions, we manually coded the fined party's name, the final amount of the fine (nominally), the duration of the cartel, and all interim amounts (base amount, entry fee, mitigating circumstances, aggravating circumstances, increase for deterrence). All other variables were coded automatically (see further below). From this data, the goal was to find out how the EC decides on fines, and, more specifically, sets interim amounts. Our starting hypothesis is that the EC has a fining policy that is more specific than the one presented in the Fining Guidelines. The EC's actual fining policy could be more specific than the Guidelines in at least three ways. Firstly, the EC could rely on factors *not* mentioned in the Fining Guidelines (e.g., the cartelists' nationality). Secondly, the EC could have a more specific interpretation of factors that *are* mentioned in the Fining Guidelines (e.g., relying only on some of the aggravating or mitigating circumstances listed). Thirdly, the EC could have more specific guidelines on the fine amounts within each intermediate step (e.g., not just setting a base amount at the 'higher end' of the 0-30% of sales scale, but consistently at 20%). We are agnostic as to whether the EC has more specific internal guidelines; our goal is simply to find patterns in the body of fining decisions. If a clear pattern emerges, a formula can be assumed to exist. In that case, the goal is to reverse engineer that formula from the fining decisions.

However, any reverse engineering exercise has to start out by proving that there is an object to replicate—that the aforementioned pattern actually exists. Only after it is determined that there *is* an object can we *reconstruct* that object by figuring out what the building blocks are—in this case, the factors taken into account by the EC when setting fines. Therefore, the first hypothesis to test is: 'The EC has a consistent cartel fining methodology'. We do so by searching for a consistent invariance within the dataset, meaning consistency over time. We apply a standard analysis of variance ('ANOVA') test, which statistically determines if variance differs between groups. If a difference is found, the groups can be considered distinct on the tested criteria. Between 2006 and 2020, three different Commissioners headed the EC's DG COMP (Neelie Kroes, Joaquín Almunia and Margrethe Vestager). Given that the Commissioner for Competition sets priorities and guides enforcement, splitting the set into three groups—one per Commissioner—and then comparing them serves as a logical starting point. If there is no consistency between Commissioners, their tenures can be further split up to seek consistency within. Once we find time periods with a certain homogeneity of variance (i.e., no statistically significant difference), we can assume the EC used one consistent approach during this time, or in other words, that a fining formula exists.

Next, we reconstruct the formula used during these invariant periods. We start by selecting variables that could *plausibly* influence the fine by looking at the Fining

Guidelines, EC decisions (e.g., 'sector/industry was in crisis'), and discussions by scholars (e.g., the parties' nationality). We finally selected 29 variables, which can be found in the table below (including an indication on which basis we selected the variables).

variable	selected based on	variable code
Settlement Notice applied	Settlement Notice	V1
parties have a large *combined* market share	prohibition decisions	V2
recidivism	Fining Guidelines	V3
repeated recidivism	Fining Guidelines / prohibition decisions	V4
cartel leader	Fining Guidelines	V5
ended involvement after intervention	Fining Guidelines / prohibition decisions	V6
effective cooperation (outside of Leniency Notice)	Fining Guidelines / prohibition decisions	V7
sector/industry was in crisis	prohibition decisions	V8
specific regulatory regime	prohibition decisions	V9
market share exceeds 60%	prohibition decisions	V10
agreement was implemented	Fining Guidelines / prohibition decisions	V11
fixed prices *by exchange of information*	Fining Guidelines / prohibition decisions	V12
exchanged commercially sensitive information	prohibition decisions	V13
fixed prices	Fining Guidelines / prohibition decisions	V14
allocated the market	Fining Guidelines / prohibition decisions	V15
long enforcement proceedings	prohibition decisions	V16
infringement covered entire EEA/EU	Fining Guidelines / prohibition decisions	V17
infringement went beyond EEA/EU	Fining Guidelines / prohibition decisions	V18
local infringement	Fining Guidelines / prohibition decisions	V19

infringement covered a few Member States specifically	Fining Guidelines / prohibition decisions	V20
new type of infringement	Fining Guidelines / prohibition decisions	V21
party avoided the agreement	Fining Guidelines / prohibition decisions	V22
unaware of the unlawful nature of conduct	Fining Guidelines / prohibition decisions	V23
negligence	Fining Guidelines / prohibition decisions	V24
follow-my-leader/minor role	Fining Guidelines / prohibition decisions	V25
U.S. company	scholarship	V26
failed to cooperate	Fining Guidelines / prohibition decisions	V27
very large turnover	Fining Guidelines / prohibition decisions	V28
EU undertaking	scholarship	V29
year of last decision	/	Nr [> or < X]
relevant sales	Fining Guidelines	Sales

Figure I: Table of 29 variables included in analysis

Given that there are almost 500 separate fines, manually checking the *actual* presence of each variable is immensely time-consuming, which is why we automate this process through 'regular expressions' ('regex') (see the R script in annex 3).[54] This is where the methodology becomes computational.[55] According to this method, each decision is checked for the regex phrases indicative of a certain variable. For example, '*(sector|industry).{0,30} in.{0,30}? (crisis|poor|trouble)*' is the regex indicative of variable V8 'sector/industry was in crisis'.[56] To decide which regex's presence is a good proxy for each variable, extracts containing the keywords for one of 17 factors[57]

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[54] Annex available at Bruno Van den Bosch, DG COMP Fining Practices, https://github.com/Bruno-Van-den-Bosch/research-DG-COMP-fining-practices.

[55] As such, our research fits within the recent computational antitrust movement. For examples, *see* Stan. Computational Antitrust, Publications, https://law.stanford.edu/codex-the-stanford-center-for-legal-informatics/computational-antitrust-publications/.

[56] Some variables relate only to one party (*e.g.*, recidivism). In these cases, the name of the party is included in the regex and a second control search phrase '*Commission.{0,40}? not.{0,700}*' is added to prevent capturing parties' arguments for a certain variable that the Eur. Comm'n did not accept. Note that determining the regex strings necessarily involves trial and error.

[57] These factors are: 'market share', 'nature' (of the infringement), 'geographical scope', 'implemented', 'price fixing', 'market sharing', 'qualitative output limitations', 'recidivism', 'cartel leader', 'ended after intervention', 'negligence', 'limited involvement', 'avoided the conduct', 'effective cooperation', 'governmental involvement', 'large turnover', 'effective enforcement'.

mentioned in the Fining Guidelines were automatically checked for overlapping consistent wording. Some (e.g., 'geographical scope') were then divided into more specific variables (e.g., 'infringement went beyond the EEA/EU'). For less frequent factors and case-specific situations, the regex phrases were determined manually.[58]

To calibrate the automatic categorization and to assess the variables included, we use a test model with a machine learning training method. More specifically, the model makes use of the 'XGBoost tree' method and—as verification—the 'randomForest' package, both of which make use of (regression) decision trees. The model decides on the basis of multiple (sometimes even conflicting) trees for the same decision. For each interim percentage (base, entry, mitigating, aggravating and deterrence), the variables' predictive value was tested. This second step was completed once the test model achieved very high predictive results: a coefficient of determination ('R2') close to 99% and an error rate ('RMSE') in the realm of a few millions.

It thus becomes clear there is a consistent cartel fining formula. However, given the test model's obscure *modus operandi* (using *multiple* trees), we do not know what that formula is. The problem shifts from the EC's black box to an AI black box. Therefore, we subsequently uncover a transparent formula by plotting *one* determinant tree for each interim amount using the final model. Almost the same script as in the previous step is used for the automatic composition of the final dataset and the machine learning model fitting thereon. The crucial difference is that instead of an opaque machine learning technique, the final script uses the 'Rpart' method. By recursive partitioning, the model builds regression trees for each intermediate amount. Another difference with the test models is that this step is done twice: once as a classification model and once as an actual decision tree regression. In the first step, the dependent variable is a binary factor (0 or 1) to determine whether a fining step was even applied—mitigating factors, for example, are only applied in a few cases. In the second step, only a filtered training set is used, which means that per interim amount only the non-zero instances are included so that the null values do not confuse the specific amount's accuracy.

Next, these trained models are put in the right order to form the approximated fining formula. Each interim amount is thus predicted by multiplying the first

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[58] *E.g.*, reductions for long proceedings are not common. After a manual check of these decisions, the regex '*total period of investigation.{0,70} more than*' was used. Similarly, governmental encouragement of cartels is rare. A notable exception is legislation concerning exotic fruits. After checking Comm'n Decision COMP/39188, Bananas, and Comm'n Decision COMP/39482, Exotic Fruit, the regex '*(sector|industry).{0,50} subject to a .{0,80} (regulatory|legislative|administrative) regime*' was set.

model (either 1 or 0) with the second model (the amount). We know this final formula to be very close to the EC's cartel fining formula because we included the following robustness checks. Firstly, the complete set was split per formula rendered in a test and training set. Moreover, the script ran two times with a varied training control: once the training control was cross-validation and once it was standard bootstrapping. The 'test/train' split was repeated multiple times for each script. For each interim amount the split was done at least 50+ times. If the test set fines can be consistently predicted, there is already some indication of the model's accuracy. And, if the decision trees are similar for each 'test/train' split, the model did not just overfit on the given training data since that data is different each time. The model then represents the actual decision-making process. Lastly, we also predicted each fine to see if there were large outliers and plotted this analysis for a visual check (see the figures under Section III).

It needs to be acknowledged that independent variables in the dataset are composed automatically. Therefore, some slight coding errors are bound to exist. Moreover, the EC uses rounded figures after each step. Our model does not because this would complicate matters. Therefore, the error rate will be non-zero, keeping us shy of a 100% accuracy rate. Finally, focusing on individual fines ('instances') rather than complete fining decisions (which contain multiple fines) means that decisions with more fined parties are given more weight in the analysis. While this method may underestimate the value of complete decisions, working with individual fines is necessary to catch firm-specific variables (e.g., 'very large turnover').

As explained above, the final model is composed of multiple models fitted to the interim amounts of the fine. The composition of these amounts is done according to the Fining Guidelines (see the step-by-step description *supra*, Section I). Importantly, given that we are predicting *interim* amounts, we do not account for reductions applied *after* the standard methodology was applied. These reductions are granted for: leniency, settlements, legal maximum (10% of turnover in the preceding business year), compensation for a long duration of the investigation, and ability to pay.[59] Some clarifications are in order. For 'ability to pay', the information is often redacted in EC decisions. We can only partially figure out which party successfully applied for a reduction, i.e., the parties that do feature in the fining calculation but have a zero fine imposed that cannot be explained otherwise. 'Ability to pay' could therefore be taken into account by reducing the fine to zero after the complete calculation is done (see "ability_pay" in figure 2). This is, however, imperfect given

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[59] We also manually extract those amounts but do not predict them. We only use them to check our predictions against the final nominal amount of the fine.

that inability to pay can also lead to a more limited fine reduction.[60] The legal maximum is also only taken into account at the very end and instances exceeding the legal maximum (and thus benefiting from a reduction) are filtered out. Last year's turnover (the basis of the legal maximum) is not standardly mentioned in the fining decision, which is why the legal maximum variable had to be coded manually.

Although instances involving the factors inability to pay or legal maximum are not used for final predictions, their interim amounts (e.g., base amount, entry fee) are used to train the model since the influence of these factors is only accounted for afterwards. Other reductions after application of the standard fining methodology are taken as a given, meaning their values are inserted directly into the fine composition (see 'LA' in figure 2). This goes for leniency and settlement and, at least under Commission Kroes, for an exceptional reduction for the long duration of the investigation.[61] Finally, we also take the duration of the infringement as a given. The effects of duration are fixed: the Fining Guidelines specifically state that the base amount is increased by the number of years an infringement lasts. Beware that the EC initially rounded up this factor to the nearest half year but calculated on a more accurate basis later on (sometimes even taking days into account).

The reverse engineered model's accuracy is assessed both based on fines predicted nominally (as they are also presented in EC decisions) and based on fines predicted as a percentage of relevant sales. The latter prevents bigger fines from disproportionally weighing on the model's accuracy. Since accuracy is determined by the average error rate, overshooting a multi-million fine by a few 100.000 EUR would weigh heavily if the other fines were only in the realm of a few 1.000 EUR, even if all fines only have a 1% error rate. On the other hand, to ensure the model doesn't fit an inaccurately composed percentage-wise fine, the final say on the model's accuracy is still the prediction of the nominal fine as featured in the EC's decision.

In the script, the fine's composition looks as follows:

```
predictedvalueswithbuild <-
(1-test.data[["ability_pay"]])*(test.data[["Sales"]]*
((((((BApredicted)*(test.data[["duration"]]))+(AApredicted*INITAApredicted))*
(1+((Aggravpredicted*INITAggravpredicted)-(Mitigpredicted*INITMitigpredicted))))
*(1 +(Detepredicted*INITDetepredicted)))*(1-test.data[["LA"]]))))
```
Figure II: Composition of model according to the Fining Guidelines' formula

[60] At the end of day, this methodological choice is justified because the instances of inability to pay reductions are limited and we needed a way to account for zero fines. Also, note once more that the model is in any case based on intermediate amounts which are unaffected by the (in)ability to pay.
[61] Under later Commissioners, this is treated as a mitigating circumstance. *See infra* Section III.

BA meaning base amount; AA meaning additional amount; Aggrav meaning the aggravating circumstances increase; Mitig meaning the mitigating circumstances decrease; Dete meaning the increase to ensure deterrence; "LA" meaning all reductions external to the model, incl. the leniency amount; "ability_pay" meaning whether the variable was applied (1) or not (0); Sales meaning the amount of relevant sales; the factors headed by 'INIT' are the binary categorization predictions (1 or 0); test.data means the dataset of test fines

A computational methodology only works when there are enough data points. By contrast, when certain interim steps (e.g., mitigating or aggravating circumstances) were not often applied, computational analysis was unhelpful. In that case, we doctrinally checked the decisions that *did* feature a non-zero amount for those steps. Given that those decisions were few, we could be comprehensive in our analysis, which is why the method may be more aptly described as systematic content analysis rather than 'traditional' doctrinal analysis.[62]

III. Results: The Commission's Fining Formula(s)

A. General Results: Relevant Factors and Accuracy of Discovered Formula

After running the first script, we get the following results (see annex 2 for the full results).[63] Comparing all three Commissioners at once, for all intermediate amounts the difference in variance is statistically significant (the ANOVA test's p-value <0,001). There is thus no consistency for the entire 2006–20 period. If we compare Commissioner Kroes with Commissioner Almunia, we also see a statistical difference in variance for the fine calculation before deterrence (p <0,001). However, for deterrence there is no statistical difference (p >0,1). This means the variation between these amounts is very similar in both time frames; at least there is no statistical indication that both sets originate from different situations (here, meaning the decision-making process). Therefore, it seems these amounts were determined in a very similar way by both Commissioners. If we compare Commissioner Almunia's fines with those imposed by Commissioner Vestager, we see no statistical difference (p >0,1) for any amount except for the aggravating circumstances increase. We can therefore presume that the last two Commissioners applied a very similar fining formula. If the Commissioners were to apply a case-by-case approach, it would be too large a coincidence for the variance to show no difference. Given the existence of a fining formula, the second part of the research methodology can therefore be implemented.

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[62] *See* Or Brook, *Politics of Coding: On Systematic Content Analysis of Legal Text, in* THE POLITICS OF EUROPEAN LEGAL RESEARCH: BEHIND THE METHOD (Marija Bartl & Jessica Lawrence eds, Edward Elgar 2022).

[63] Annex available at Bruno Van den Bosch, DG COMP Fining Practices, https://github.com/Bruno-Van-den-Bosch/research-DG-COMP-fining-practices.

Based on the methodology set out above, three different cartel fine formulas were composed: the first for fines under Commissioner Kroes, the second for fines under Commissioner Almunia, and the third for fines under Commissioner Vestager. Additionally, a formula combining the fines under the last two Commissioners was composed to see if there was a longer-term method.

Via these formulas, another piece of information was revealed, namely the relevant sales of each fined party. That amount is generally redacted in EC decisions, or only a magnitude is given.[64] However, once we calculate the fines based on interim amounts, we can express them as a percentage of relevant sales ('the constructed percentage'). We can then divide the nominal amount of the fine by that constructed percentage to arrive at the relevant sales of the fined party. We checked these numbers against the magnitude indicated by the EC, which did not point to any errors. As a result of the uncovered relevant sales, we could predict fines in their final nominal amount *and* compare those predictions directly against the fines noted in the decision.

The final formula's accuracy is stated in the table below. Remember that the analysis ran for 50+ test/train splits each time, once using bootstrapping and once using cross-validation (CV) as train control. However, the different training methods did not change the result. The script also ran including and excluding the sector variable in an effort to exclude 'overfitting' as an explanation for the high predictive values. The results are distinguished in the table since they differ slightly. However, the difference is negligible as R2 values are only around a percentage point apart. In addition, the fork of the worst and best model's value is shown insofar as there is a (rounded) percentage point difference.

Commissioner	R2	RMSE	R2	RMSE
	calculated on the nominal fine (as imposed in the EC decision)			
Kroes	87–93%	≈ €30 000 000	86–92%	≈ €33 000 000
Almunia	99%	≈ €4 000 000	99%	≈ €4 000 000
Vestager	≈98%	≈ €5 000 000	≈98%	≈ €4 500 000
Almunia & Vestager	99%	≈ €5 000 000	93–99%	≈ €5 000 000
	CV train control and no sector		*CV train control and sector included*	
	calculated on the final fine as percentage of relevant sales			
Kroes	87–90%	≈0,40	91–94%	≈0,30
Almunia	97–99%	≈0,07	98–99%	≈0,05

[64] In accordance with Eur. Comm'n, Guidance on the Preparation of Public Versions of Commission Decisions Adopted under Articles 7 to 10, 23 and 24 of Regulation 1/2003 (Jan. 14, 2021).

Vestager	≈94%	≈0,13	94–95%	≈0,12
Almunia & Vestager	96–97%	≈0,10	96–97%	≈0,10
	boot train control and no sector		*boot train control & sector included*	

Figure III: Table summarizing the model's predictive values

Further, the last two Commissioners' lowest predictive values are the exception. All of Commissioner Almunia's runs—with and without the sector variable—have an R^2 of around 99% (for both CV and boot train control). For Commissioner Vestager, R^2 is also consistently at the 98% mark—slightly better when the sector variable is included. The close fit between predicted and imposed fines also holds when the fine is expressed as a percentage of relevant sales. Visually, we also see fines are predicted very accurately: predicted fines closely track actual fines imposed (figures 4 and 5). There does not seem to be any benefit in combining the last two Commissioners' fines in one set: predictions become somewhat less accurate. Nonetheless, the predicted values do suggest Commissioners Vestager and Almunia used a very similar methodology. In short, since we are able to predict fines given by the EC under Commissioners Almunia and Vestager with such accuracy, it follows that they follow a remarkably consistent methodology.
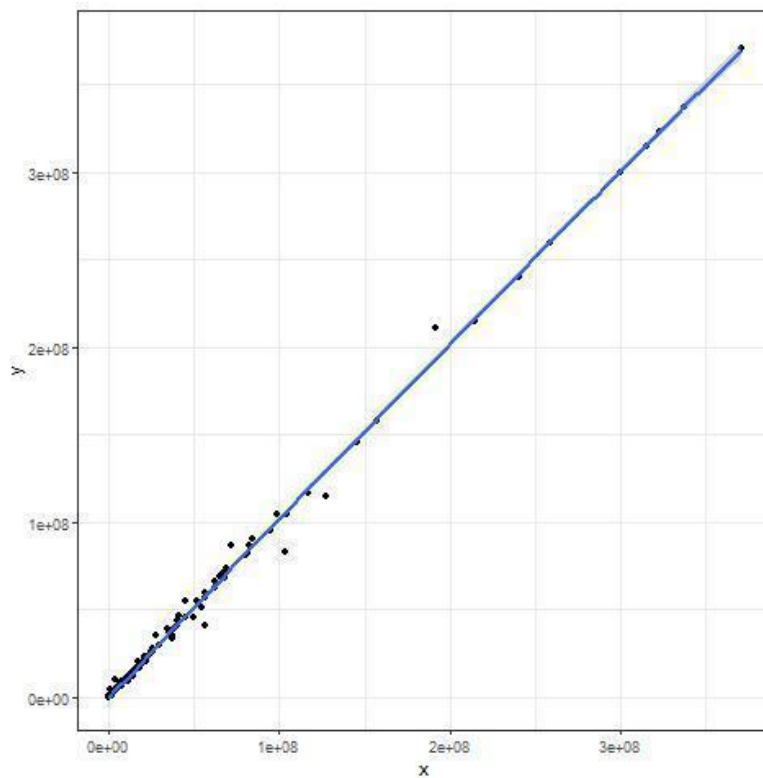

Figure IV: Predicted vs actual fines for Commissioner Almunia
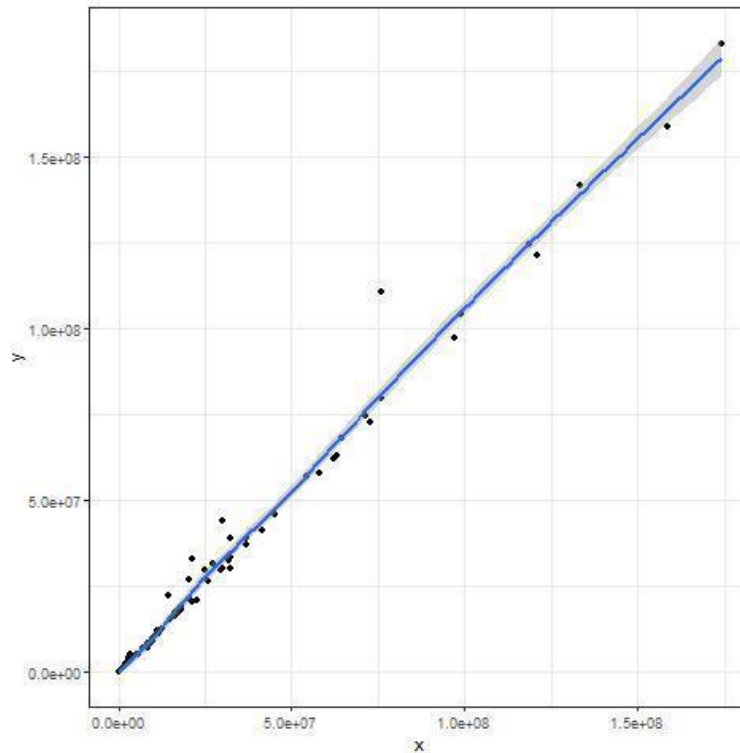
Figure V: Predicted vs actual fines for Commissioner Vestager

Contrary to the very close fit for fines of the last two Commissioners, Commissioner Kroes' fines are more difficult to predict.[65] It is still possible to observe a trend but not much more. This might be explained by the fact that Commissioner Kroes used (some) different variables—not only different variable weights—in the fining methodology, or the fining process was simply less consistent at the time. Still, the model does significantly increase predictability. Only on the basis of sales, fines are predictable for around 50%.[66] Using the model, R^2 still reaches 90% consistently (and often even 92%).

For the last two Commissioners their supposed fining formula is presented in detail below (sections C and D). For Commissioner Kroes only a discussion of the fining track record is given (section B). Before moving on to the specific results, however, a final word of caution is warranted. Although our quantitative model is

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[65] Based on 107 fines from 13 decisions.

[66] Meaning R2 is around 50% when the script is run with only the independent variable 'sales' included.

built to minimize overfitting and maximize predictive value, legal decisions are by definition case-based, which means outliers are to be expected. There is a risk of excessive complexity, meaning the model fits outlier cases that it should have ignored. Therefore, 'handle with care' when interpreting the results.

B. Commissioner Kroes' Cartel Fining Practices (2006–10)

As a rule, it seems that the base amount—'set at a level of up to 30% of the value of sales' according to the Fining Guidelines[67]—was set fairly invariantly during Commissioner Kroes's tenure. Before 2008, the amount would have been 17%; before 2009, it would have been 20%. After 2009—during the last year of her tenure—Commissioner Kroes started taking the magnitude of relevant sales into account. The EC imposed a lower base amount (17%) when the relevant sales were already at the high end. Otherwise, the EC imposed a high base amount (24%), except in cases involving a new type of infringement (V21), where the base amount was set at 19%. This inverse adjustment of the base amount (percentage) to relevant sales is somewhat reminiscent of the 1998 Fining Guidelines, according to which fines were set based on the *type* of infringement independently of the undertakings' size. This methodology resulted in more comparable nominal fines for similar infringements. However, a side effect of the adjustment is that undertakings with lower relevant sales received base amounts close to the 30% limit, which is unseen under subsequent Commissioners (see sections C and D).

Commissioner Kroes's formula for setting the base amount of cartel fines is shown in the decision tree below. To read this decision tree—and those that follow—some explanation may be helpful. Each tree is composed of nodes and lines tracking a path between the nodes ('branches'). Each node shows a fraction indicating the model's output—in this case, the percentage of relevant sales (e.g., '0,24' bottom right) and the proportion of cases flowing through this node (e.g., '13%' bottom right). Below each node, a relevant variable is included (e.g., V21). To know which path to follow to the next node, one needs to answer a yes-or-no question. For example, under the bottom right node, the question asked is whether the variable V21 is present (V21 = 1). If this is the case, the path to the left ('yes') must be followed; if it is not, the path to the right ('no') must be followed. Be mindful that the question may also concern the variable's absence (e.g., V21 = 0), in which case 'no' (a double negative) signifies the *presence* of the variable. Finally, there are two specific variables, relevant sales ('sales') and year of last decision ('nr'), which do not equal 1 or 0 but are greater (>) or smaller (<) than a specific number.

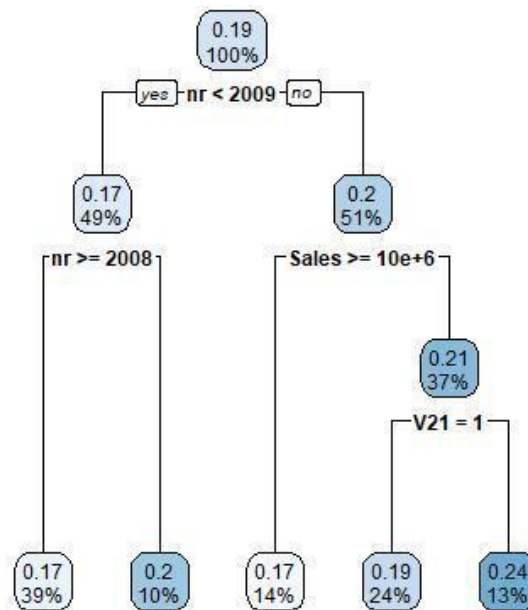[67] Fining Guidelines, *supra* note 3, para 21.

Figure VI: Base amount fine under Commissioner Kroes

'nr' represents the year of the fining decision; 'Sales' represents the magnitude of relevant sales; V21 represents whether the type of infringement was considered new (R2 on test set: 0,907024; R2 on complete set 0,712861; train control CV; seed 39)

The entry fee—'a sum of between 15% and 25% of the value of sales'—was always applied, according to the Fining Guidelines so as to 'deter undertakings from even entering into horizontal price-fixing, market-sharing and output-limitation agreements'.[68] Despite the different fork, its amount follows the base amount closely. However, contrary to later Commissioners, who always applied an identical percentage for the base amount and entry fee, Commissioner Kroes applied an entry fee 1%-point lower than the base amount.
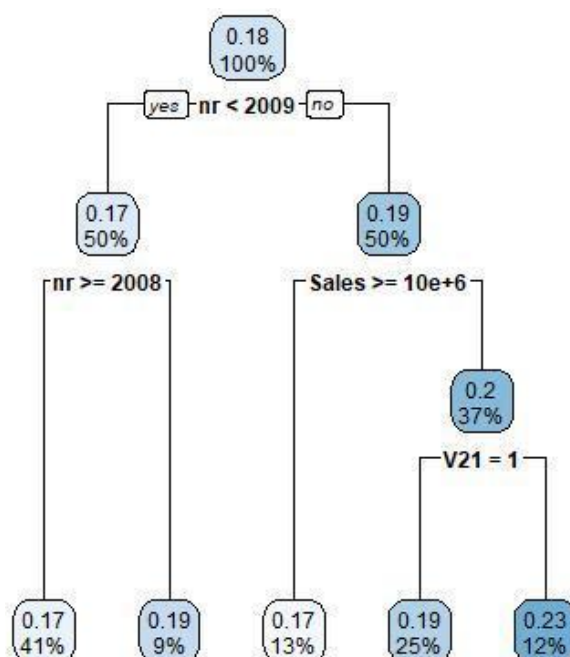
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[68] *Id.* para 25.

Figure VII: Entry fee under Commissioner Kroes

'nr' represents the year of the fining decision; 'Sales' represents the magnitude of relevant sales; V21 represents whether the type of infringement was considered new (R2 on test set: 0,941616; R2 on complete set 0,705581; variable sector not included; train control CV; seed 1298)

When it comes to aggravating circumstances, it is clear what drove the application of the increase. In line with the Fining Guidelines, the amount is applied for either recidivism, cartel leadership, or refusal to cooperate.[69] It is less predictable how the amount itself is decided on, which explains the low R2 of the model for Commissioner Kroes. Yet, where a computational analysis falls short, a doctrinal analysis proves more effective. For the first factor, i.e., recidivism, the exact increase applied was mostly either 50% or 60%. Twice, however, the EC applied considerably higher amounts: once the absolute legal maximum for recidivism—a 100% increase,[70] and once a 90% increase.[71] The increase applied to cartel leaders is less consistent: in one case it was 50%,[72] in another only 30%.[73] Finally, in a unique case the EC accused the firm of refusing to cooperate and applied a 30% increase.[74]

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[69] *Id.* para 28.

[70] Akzo Nobel in Comm'n Decision COMP/39396, Calcium Carbide and Magnesium Based Reagents for the Steel and Gas Industries.

[71] Arkame in Comm'n Decision COMP/38589, Heat Stabilisers.

[72] Sasol in Comm'n Decision COMP/39181, Candle Waxes.

[73] Bridgestone in Comm'n Decision COMP/39406, Marine Hoses.

[74] Sony in Comm'n Decision COMP/38432, Professional Videotape (Sony blamed the behavior on a junior associate, but to no avail).

For the mitigating circumstances decrease, it is again more useful to rely on a doctrinal approach. Under Commissioner Kroes, the EC applied a mitigating circumstances decrease only to five undertakings (compared to ~30 for her successors).[75] Although this makes computational analysis difficult, it is still possible to deduce some ground rules. Again, the fining practices follow the Fining Guidelines, although some of the factors that can justify a decrease according to the guidelines are never relied on (e.g., that the infringement was a result of negligence, which neither of the following Commissioners relies on either).[76] First, undertakings under a specific regulatory regime that supported the infringement (a quota regime for bananas) received a decrease of 60%, reflecting the extent of the regime in question.[77] Second, two undertakings in the same case received an 18% decrease for showing effective cooperating outside the scope of the Leniency Notice (the same amount Commissioner Almunia later applied).[78]

The quantification of the specific increase for deterrence is also unknown (R^2 <5%), but the model gives some guidance as to when the amount was applied. For this increase, the Fining Guidelines single out 'undertakings which have a particularly large turnover beyond the sales of goods or services to which the infringement relates.'[79] It is clear that undertakings with high sales (exceeding 52M EUR) are likely to receive the increase,[80] although new type of infringements would not (V21). These steps feature in virtually all models. It also seems recidivists (V3) were likely to receive the increase as a few models show some relation. The amount thus mostly seems to reflect the undertakings' size. Those large undertakings risk a 10% or 20% increase. However, when the increase for deterrence is applied to undertakings whose relevant sales are only a small fraction of their total turnover, the increase can go beyond 50%.[81] The exact number used once past 20% varies widely, which makes drawing further conclusions difficult. It is noteworthy that the second ground for deterrence

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[75] In Comm'n Decision COMP/38589, Heat Stabilisers, the parties exceptionally received a 1% fine reduction to account for the 'considerable' duration of the proceedings. However, this is not a mitigating circumstance.

[76] Fining Guidelines, *supra* note 3, para 29.

[77] Comm'n Decision COMP/39188, Bananas.

[78] Alstom and Hitachi in Comm'n Decision COMP/39129, Power Transformers.

[79] Fining Guidelines, *supra* note 3, para 30.

[80] This may align with the Fining Guidelines but is not identical: we found that the undertaking's magnitude of tainted sales in itself helps predict the fine—not the magnitude of tainted sales as compared to the undertaking's sales of other goods or services, which we did not test as a variable.

[81] *See* Comm'n Decision COMP/39181, Candle Waxes. The EC applied deterrence increases of 100% and 70% because the value of relevant sales represented respectively 0,01% and 0,03% of the undertakings' total turnover.

increases—i.e., 'the need to increase the fine in order to exceed the amount of gains improperly made as a result of the infringement'—was never applied.[82]

C. Commissioner Almunia's Cartel Fining Formula (2010–14)

It is clear how the EC set fines under Commissioner Almunia. The fines can be approximated very closely (figure 4) except for one step: during his tenure, the EC imposed an increase for aggravating circumstances only thrice,[83] which are too few instances both to reverse engineer the aggravating circumstances methodology and for this gap to have an impact on the model formula's accuracy. Where the model could not fit the data, a doctrinal analysis did bring clarity.[84] Commissioner Almunia's apparent cartel fine formula is described in the following paragraphs.

When it comes to the base amount, we see a slight shift in policy (figure 8). First, consistent across model runs, infringements considered new (V21) receive an 18% base amount. Infringements not considered new were fined differently over time. Before 2014, the base amount was set at 16%, even if the infringement was EU-wide (V17). If undertakings divided national markets amongst each other (V15), however, the amount was set at 19%. After 2014, the base amount was set slightly higher, at 17%. It is already interesting to note here that—contrary to Commissioner Kroes (see above) and the current fining practice under Article 102 TFEU[85]—new infringements receive a *higher* rather than lower base amount.

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[82] Fining Guidelines, *supra* note 3, para 30. Furthermore, in Comm'n Decision COMP/38629 Chloroprene Rubber, the amount of gains is even said to be unquantifiable but the undertakings' size and sales beyond the cartelized product was considered sufficient reason for the increase. In Comm'n Decision COMP/38432, Professional Videotape, Sony explicitly argued against the deterrence increase because the 'gains were modest' and likely to be captured by the entry fee. The EC considered Sony's size to be reason enough for the increase. Other cases also justify the increase not based on the gains but based on the undertakings' size. See Comm'n Decision COMP/39181, Candle Waxes; Comm'n Decision COMP/38628, Nitrile Butadiene Rubber; Comm'n Decision COMP/38589, Heat Stabilisers; and Comm'n Decision COMP/39129, Power Transformers.

[83] ArcelorMittal and Saarstahl in Comm'n Decision COMP/38344, Prestressing Steel and ABB in Comm'n Decision AT.39610, Power Cables.

[84] The doctrinally determined step was not included in the prediction fits.

[85] The EC usually does not impose a fine when it finds a new type of infringement, see, e.g., Comm'n Decision AT.39985, Motorola - Enforcement of GPRS Standard Essential Patents (under Article 102 TFEU) and Comm'n Decision AT.40208, International Skating Union's Eligibility Rules (under Article 101 TFEU).
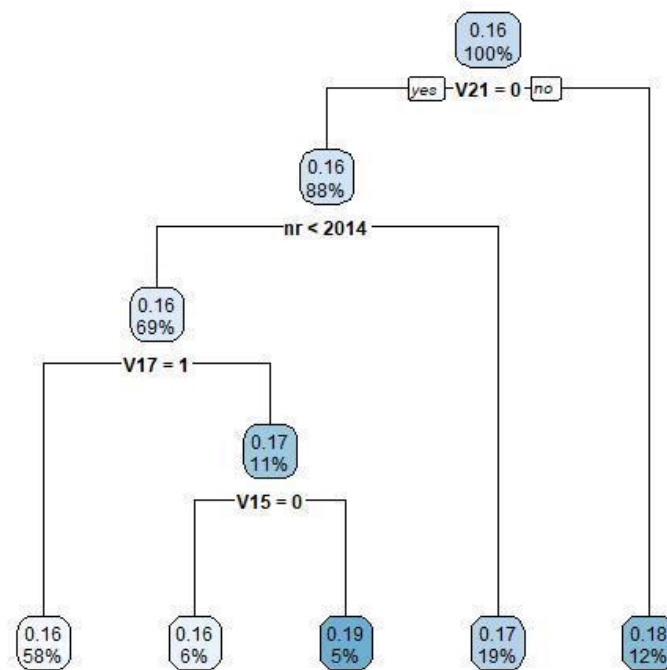
Figure VIII: Base amount fine under Commissioner Almunia

V21 represents whether the type of infringement was considered new; 'nr' represents the year of the fining decision; V17 represents whether the infringement covered the entire EEA/EU; V15 represents whether cartelists allocated the market (R2 on test set: 0,544425; R2 on complete set 0,640733; variable sector not included; train control CV; seed 38)

Next, the EC generally applied an entry fee under Commissioner Almunia (figure 9). Exceptions are limited to four decisions where the entry fee was not applied to all undertakings.[86] This again complicates computational analysis. Nonetheless, upon closer examination, we see those cases categorised as small-scale infringements either due to the scope of the infringement (absence of V18, presence of V20) or the size of the undertaking (sales). There are some test models which fitted the protectionist variable V29 (e.g., seed 28, 34, 36). These outlier models suggest EU undertakings generally did not receive an additional amount. However, R2 on the complete dataset was only 15%. Moreover, there is a logical explanation for the outlier models and their lower predictive value. U.S. undertakings are generally active beyond the EU, active on large(r) parts of the EEA/EU market, and simply large(r). Hence, in certain training datasets the model might have fitted the EU variable as a proxy for more small-scale infringements. Relying on the multiplicity

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[86] See Comm'n Decision COMP/38511, DRAMs; Comm'n Decision COMP/38344, Pre-stressing Steel; Comm'n Decision COMP/39452, Fittings for windows and balcony doors; Comm'n Decision AT.39681, Yen Interest Rate Derivatives.

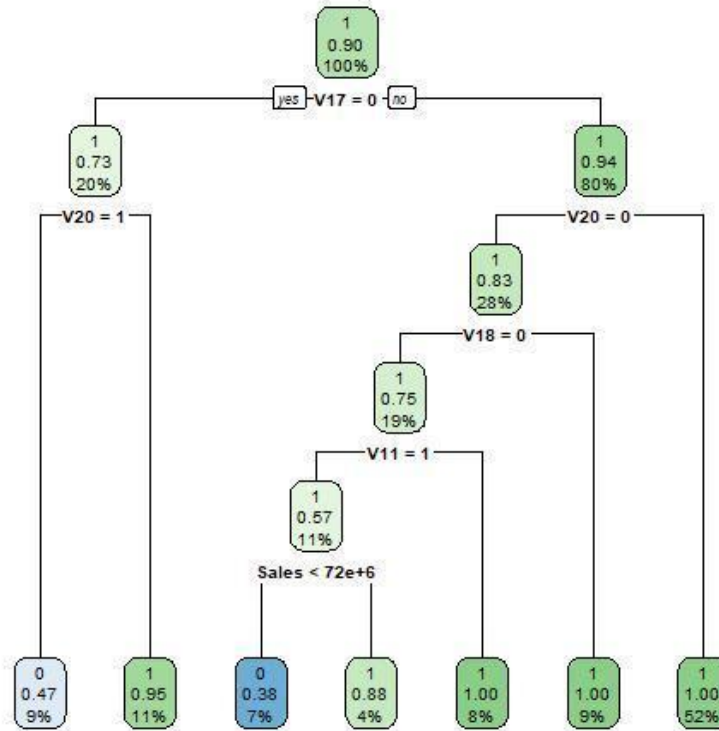of variables rather than the protectionist variable yields better predictive results (R2 of ~40%).

Figure IX: Entry fee under Commissioner Almunia: applied (1) or not (0)

V 17 represents whether the infringement covered the entire EEA/EU; V 20 represents whether the infringement covered a few Member States specifically; V 18 represents whether the infringement went beyond the EEA; V 11 represents whether the agreement was implemented; 'Sales' represents the magnitude of sales (R2 on test set: 0,5897435; R2 on complete set 0,4840180; variable sector not included; train control CV; seed 6789 (R2s determined on final amount))

As is the case for the base amount, new types of infringements remarkably received higher entry fees, i.e., of 18% of relevant sales (figure 10). There might again be some concern that this variable indicates protectionism given that it was applied mostly to non-EU undertakings.[87] However, in the same cases, the increase was also applied to the EU undertakings,[88] which argues against the protectionist hypothesis and explains why the model did not see fit to use the protectionist variables. If the type of infringement was not considered new, the additional amount was set relatively consistently at 16% before 2014 and 17% thereafter.

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[87] Chunghwa, Samsung, Panasonic, LG Electronics, Toshiba in Comm'n Decision AT.39437, TV and Computer Monitors Tubes; ICAP, JPMorgan Chase in Comm'n Decision AT.39861, Yen Interest Rate Derivatives.

[88] Koninklijke Philips Electronics in Comm'n Decision AT.39437, TV and Computer Monitor Tubes and HSBC in Comm'n Decision AT.39861, Yen Interest Rate Derivatives.
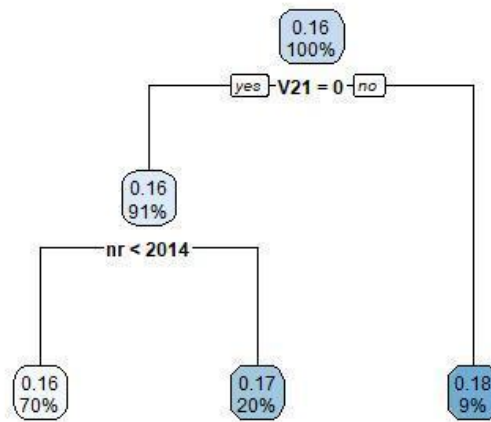
Figure X: New types of infringements lead to higher entry fees

Decision tree final node shows base amount as integer and percentage of cases from training set categorized; 'nr'
is the year of the fine; V21 represents whether the type of infringement was new (R2 on test set: 0,819906;
R2 on complete set 0,752335; variable sector not included; train control CV; seed 334778)

As mentioned before, the model was not fit for the aggravating circumstances increases given that those were applied only three times—always to recidivists.[89] It can thus be said that in principle there are no aggravating circumstances increases except for recidivism, in which case a 50% increase is applied.[90] This amount is again only half the increase foreseen by the Fining Guidelines, which allow a **100%** increase.[91] It is also higher than the increase applied by Commissioner Kroes.

There are 28 instances where Commissioner Almunia applied mitigating circumstances; in those, nine different specific amounts are used. It is difficult to computationally discern a pattern with few and varied instances, but a closer look at the decisions is once more illuminating.

Firstly, exceptional regulatory regimes also played a role here, even with reference to the *same* regime[92] as under Commissioner Kroes.[93] The deduction was, however, significantly lower: only 20% compared to the previous 60%. The EC

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[89] ArcelorMittal and Saarstahl in Comm'n Decision COMP/38344, Prestressing Steel; ABB in Comm'n Decision AT.39610, Power Cables.

[90] Looking at the dataset, however, some firms feature multiple times without having the increase applied.

[91] Fining Guidelines, *supra* note 3, para 28.

[92] Council Regulation No. 404/93, 1993 O.J. (L47/1) (on the common organisation of the market in bananas).

[93] Comm'n Decision COMP/39188, Bananas.

distinguished the *Bananas* decision based on the fact that the latter only concerned coordination on *quotation* prices.[94] Given that the EC found coordination at the level of *actual* prices in *Exotic Fruit*, 'that part of the bundle of mutually reinforcing elements justifying a mitigating factor of 60% in the Bananas decision is not present in this case.'[95] The GC signed off on this reasoning, reminding us that 'the Court of Justice has repeatedly held that the Commission's practice in previous decisions does not itself serve as a legal framework for the fines imposed in competition matters and that decisions in other cases can give only an indication for the purpose of determining whether there is discrimination'.[96] However, the 'mutually reinforcing elements' explanation is somewhat curious: if the majority of the reduction (40 out of 60%) in the *Bananas* decision is attributable to the type of infringement, should the EC not—mainly or even completely—account for this factor under 'gravity of the infringement' when setting the base amount?

Secondly, in line with the Fining Guidelines, decreases were also applied for parties' substantially limited involvement in the infringement—generally of 5–15%.[97] The outlier here is Infineon in *Smart Card Chips*, which received a 20% decrease.[98]

Thirdly, and again similar to Commissioner Kroes's policy, the EC granted reduction to cooperative undertakings who did not (fully) qualify for the leniency reduction, mostly of 18% but sometimes substantially lower.[99]

Lastly, in one case all parties involved received a 10% decrease for the long duration of proceedings (6 years).[100] Interestingly, under Commissioner Kroes such a reduction was given at the end of the fine calculation—not as a mitigating

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[94] Comm'n Decision COMP/39482, Exotic Fruit (Bananas), paras 336-40.

[95] *Id.* para 339.

[96] Case T-655/11, FSL Holdings et al. v. Comm'n, 2011, ECLI:EU:T:2015:383 (Jun. 16, 2015), paras 551-52, referencing Case C-167/04 P, JCB Service v. Comm'n, ECLI:EU:C:2006:594, para 205 (Sept. 21, 2006). The GC continues: 'The Commission enjoys a wide discretion in setting the amount of fines and is not bound by assessments made by it in the past. It follows that the applicants cannot invoke the Commission's decision-making policy as an argument before the Courts of the European Union'.

[97] Toshiba (10%), Mitsubishi (10%) and Hynix (5%) in Comm'n Decision COMP/38511, DRAMs; AGC (15%) and Schot (15%) in Comm'n Decision COMP/39605, CRT Glass; Panasonic (10%) in Comm'n Decision COMP/39600, Refrigeration Compressors; ABB (5%), EXSYM (5%), Sagem/Safran/Silec (5%), Brugg (5%), Mitsubishi and Showa (prior to the formation of EXSYM) (10%), LS Cable (10%), Taihan (10%) and NKT (10%) in Comm'n Decision AT.39610, Power Cables. In the last decision, LS Cable and Taihan were granted an additional 1% reduction for their lack of awareness of and liability for parts of the single and continuous infringement.

[98] Infineon (20%) in Comm'n Decision AT.39574, Smart Card Chips.

[99] Embraco (18%) in Comm'n Decision COMP/39600, Refrigeration Compressors; Winkhaus (5%) in Comm'n Decision AT. 39452, Fittings for Windows and Balcony Doors; Schott (18%) in Comm'n Decision COMP/39605, CRT Glass; Mitsubishi (3%) in Comm'n Decision AT.39610, Power Cables.

[100] Comm'n Decision AT.39674, Smart Card Chips.

circumstance. Long proceedings are also not mentioned as a mitigating circumstance in the Fining Guidelines. However, the list of mitigating circumstances in the Fining Guidelines is non-exhaustive.[101] Therefore, nothing prevents the factor from being taken into account at this stage. Nonetheless, moving the factor to an intermediate stage amplifies its impact since it reduces the base amount *before* potential increases for aggravating circumstances and deterrence.[102]

The deterrence increase was applied 24 times, which is again too few instances to computationally derive specific guidance. A closer look shows the increase is applied for undertakings whose size is either significantly larger than the other cartelists, or just plain large. Nonetheless, the application seems to have occurred most often in the electronics sector (C26)—in ten of the 24 instances (five different firms)[103]—and on non-EU (and mostly Asian) companies—in 14 of the 24 instances (seven different firms).[104] The notable exceptions are the undertakings in *Freight Forwarding*—Deutsche Post and Deutsche Bahn—accounting for six instances.[105] These German undertakings also received the increase due to their size. As under Commissioner Kroes, the deterrence increase is either 10% or 20% depending on the undertakings' size (measured in total turnover), either in itself, compared to the other cartelists, or—in line with the Fining Guidelines—compared to the sales to which the infringement relates.

In the end, Commissioner Almunia's fines were relatively easy to predict by the model because of the fining policy's consistency. Moreover, even where a model could not be fit quantitatively, the specific fining method could mostly be uncovered qualitatively. The predictive value of the model already reached 99% in all but one test/train partition (excluding mitigating, aggravating and deterrence). Therefore, we believe the methodology set out here accurately represents the EC's fining policy under Commissioner Almunia.

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[101] Fining Guidelines, *supra* note 3, para 29. *See also id.*, para 432.

[102] As a simple example: take a base amount of 10 to which a 20% aggravating circumstances increase is applied. If the 10% reduction is a mitigating circumstance: (10*(1-(20%-10%))=9. If it is put at the end: (10*(1+20%))*(1-10%)=10,8.

[103] Hitachi and Toshiba in Comm'n Decision COMP/38511, DRAMs; Hitachi (x2), Samsung and Mitsubishi in Comm'n Decision AT.39574, Smart Card Chips; Toshiba and Panasonic (x2) in Comm'n Decision AT.39437, TV and Computer Monitor Tubes; Samsung in Comm'n Decision COMP/39309, Liquid Crystal Displays.

[104] Hitachi and Toshiba in Comm'n Decision COMP/38511, DRAMs; Hitachi and Samsung in Comm'n Decision AT.39574, Smart Card Chips; Toshiba and Panasonic (x2) in Comm'n Decision AT.39437, TV and Computer Monitor Tubes; Samsung in Comm'n Decision COMP/39309, Liquid Crystal Displays; Panasonic in Comm'n Decision COMP/39600, Refrigeration Compressors; Mitsubishi in Comm'n Decision AT.39574, Smart Card Chips; Procter & Gamble in Comm'n Decision AT.39579, Consumer Detergents; UPS (x3) in Comm'n Decision AT.39462, Freight Forwarding.

[105] Comm'n Decision AT.39462, Freight Forwarding.

D. Commissioner Vestager's Cartel Fining Formula (2014–20)

Current Commissioner Vestager's fines can also be predicted with accuracy (see figure 3 above). Interestingly, with Commissioner Vestager at the helm, the EC seems to (more) strongly take the sector into account when setting fines. The gap between most and least accurate model decreases from 3% to only 0,5% once the sector variable is included. What follows can be considered Commissioner Vestager's fining methodology for cartel fines.

The base amount is remarkably consistent: it is set at either 16% or 17% of relevant sales (figure 11). In most cases, the base amount is set at 16%. This is the case for 'local infringements' (covering a few Member States specifically) (V20), and even for non-local infringements if they are new (V21) or if market allocation was not part of the cartel arrangement (V15). If none of the previous conditions apply, the base amount is set at 17% except for infringements of which the geographical scope went beyond the EEA (V18). Undertakings with particularly high sales (exceeding 164M EUR) were also penalized with the 17% amount. The great majority of models show similar decision trees. The reason for the exceptions is that there is one case the decision tree does not fit.[106] In this case the infringement not only covered the entire EEA but also concerned undertakings with a strong jointly dominant position (80% market share) and an infringement that featured an array of anticompetitive elements. In this exceptional case the base amount was set at 18%.

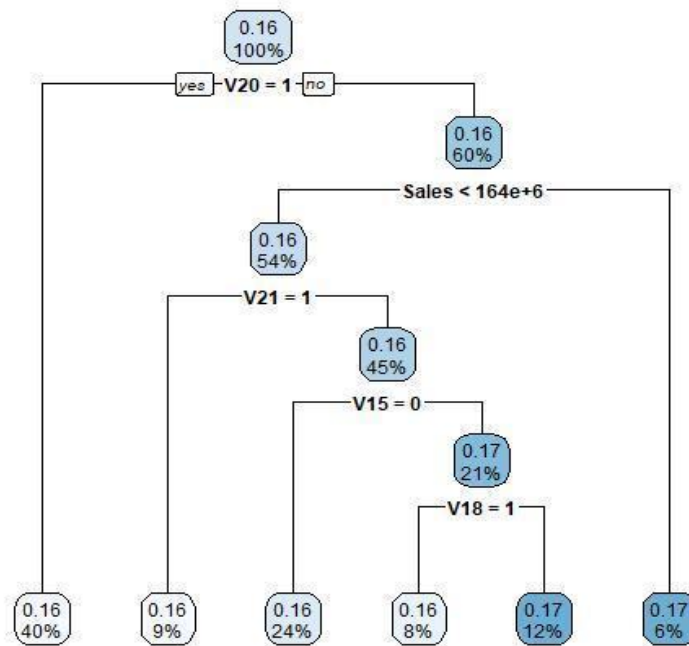[106] Comm'n Decision AT.40055, Parking Heaters.

Figure XI: The base amount is set at 16-17% of relevant sales

V20 represents whether the infringement took place locally; 'Sales' represents the magnitude of sales; V21 represents whether the type of infringement was new; V15 represents whether the infringement included market allocation; V18 represents whether the infringement went beyond the EEA (R2 on test set 0,7947847; R2 on complete set 0,5922890; both for sector variable not included and included; train control CV; seed 33)

Under Commissioner Vestager, the EC always applies an entry fee, and that fee is always *exactly* the same as the base amount. The decision tree (figure 12) and explanation are also exactly the same as for the base amount, given that the EC refers to the same elements for each component in the decision.

The Vestager-led DG COMP increased the fine only 9 times for aggravating circumstances, which is once more too few instances to fit a model to.[107] When applied, the increase was one of 50%—the same amount as applied under Commissioner Almunia. The amount is also applied to take the same circumstance into account, i.e., recidivism.

There are also very few instances of mitigating circumstances, and most are applied to undertakings in the same case. The 'specific regulatory regime encouraging the conduct' was accounted for in *Airfreight*, leading to a 15% fine

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[107] NEC in Comm'n Decision AT.40136, Capacitors; Mitsubishi and Hitachi in Comm'n Decision AT.40028, Alternators and Starters; SAS Cargo (x4) in Comm'n Decision AT.39258, Airfreight; Continental (x2) in Comm'n Decision AT.39920, Braking Systems.

reduction[108] (lower than the 60% and 20% reductions granted under Commissioners Kroes and Almunia, respectively). All other instances are situations of substantially limited involvement in the infringement. A decrease for limited involvement starts at 5%.[109] However, being uninvolved and unaware of (large) parts of the infringement results in decreases up to 20% depending on the degree.[110] In one appeal, the GC increased the 5% decrease to 8% to take the (more) limited number of agreements the undertaking was part of into account.[111] This precedent is referenced in the more recent *Infineon* judgement of the GC, which adjusted a 20% decrease to 25% for similar reasons (see further below).[112]

The final increase to ensure deterrence was applied relatively rarely (in 20 instances), with the same concerns about quantitative analyses as a result. However, the methodology seems identical to the one used by Commissioner Almunia, i.e., a 10% or 20% increase depending on how (relatively) large the undertaking is. It is noteworthy that the undertakings subjected to the increase are mostly Asian[113] and German.[114]

IV. Discussion: No Protectionism, but a Call for More Boldness in European Commission Fines—and Closer Scrutiny of Those Fines

Our research shows that, since the 2006 Fining Guidelines, the EC has set fines based on a consistent methodology. Over the last decade (2010-20), however, this consistency has been remarkable. Consistency is found both in the factors the EC takes into account when setting fines, and in the specific percentage-based fining amounts it sets for each variable. The EC's methodology in practice is perfectly in line with Fining Guidelines. Firstly, the EC sticks closely to the variables it lists in the Fining Guidelines (although some variables are rarely or never relied on). Secondly,

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[108] Comm'n Decision AT.39258, Airfreight.

[109] Magic Pack and Silver Plastics (x2) in Comm'n Decision AT.3963, Retail Food Packaging (Silver Plastic got its fine reduced with an additional 5% for cooperation outside the Leniency Notice); Campine in Comm'n Decision AT.40018, Car Battery Recycling.

[110] Tokin (x2) (10%), NEC (10%) and Sanyo (10%) in Comm'n Decision AT.40136, Capacitors; Hitachi (15%) in Comm'n Decision AT.40028, Alternators and Starters; Bosch (10%) and Denso (10%) in Comm'n Decision AT.40113, Spark Plugs; Compañía Sudamericana de Vapores (20%) in Comm'n Decision AT.40009, Maritime Car Carriers.

[111] Case T-240/17 Campine v. Comm'n, 2019, ECLI:EU:T:2019:778 (Nov. 7, 2019).

[112] Case T-758/14 Infineon Tech. v. Comm'n, 2020, ECLI:EU:T:2020:307 (July 8, 2020).

[113] *See* Denso in Comm'n Decision AT.40113, Spark Plug; Sony in Comm'n Decision AT.29639, Optical Disk Drives; Sony and Panasonic in Comm'n Decision AT.39904, Rechargeable Batteries; Panasonic in Comm'n Decision AT.40136, Capacitors; Panasonic and Denso in Comm'n Decision AT.39960, Thermal Systems; Hitachi, Denso and Mitsubishi in Comm'n Decision AT.40028, Alternators and Starters.

[114] *See* Deutsche Bahn in Comm'n Decision AT.40098, Blocktrains; Continental and Bosch in Comm'n Decision AT.39920, Braking Systems; Bosch in Comm'n Decision AT.40113, Spark Plugs.

the EC stays well within the ranges it put forward in the Fining Guidelines. Therefore, the Fining Guidelines can be said to achieve their goal of bringing coherence and transparency to the fine-setting process.

However, the consistency of the EC's fine-setting practice goes much further than alignment with the Fining Guidelines. Indeed, a formula-like approach to fine-setting exists. Section III described that formula for each Commissioner, as uncovered via the methodology set out in Section II. Importantly, those formulas tell us something about one of the drivers of this research, i.e., the protectionist hypothesis. Given the general absence of protectionist variables (V26 and V29) in the formulas, the protectionist hypothesis must be rejected—at least where the model *can* fit the data (the base amount and entry fee).[115] However, corroboration of the hypothesis might still be found where there are too few fining instances for a consistent pattern to emerge computationally. In particular, aggravating and mitigating circumstances and the increase for deterrence were not always applied often enough.

It is already clear that aggravating circumstances and deterrence rarely get a specific increase. A plausible explanation is that the gravity of the infringement is already taken into account when setting the base amount of the fine. As the GC recently stressed, an increase for aggravating circumstances can only be imposed in cases of *additional* 'unlawful conduct or circumstances which render the infringement more harmful and which justify a particular ruling' (e.g., the non-exhaustive list of circumstances in the Fining Guidelines).[116] When doctrinally examining the EC's practice for signs of protectionism, it is, therefore, *prima facie* worrying that increases for aggravating circumstances are applied more often to non-EU firms. However, those non-EU firms are not the ones generally considered the target of alleged protectionism, i.e., U.S. firms.[117] If anything, Asian firms appear to receive stricter treatment in EC fines.

While further research is warranted, we have always found a plausible explanation for the EC to apply such increases as well as their amount (e.g., the firms in question were recidivists). Moreover, these already few cases usually have counterexamples, often involving German undertakings, which also explains why

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[115] A protectionist bias could also manifest itself in case selection, although this appears unlikely in the area of cartels where enforcement priorities play a more limited role, and a large majority of cases originate from leniency applications.

[116] Case T-93/18, Int'l Skating Union v. Comm'n, 2020, ECLI:EU:T:2020:610, paras 152–53 (Dec. 16, 2020).

[117] *See supra* notes 24–26.

the quantitative trees do not show the influence of a protectionist variable within the limited pool of cases. Interestingly, these undertakings are often part of the electronics sector. Given the economic importance of this sector, a strong policy response (which the EC is free to pursue) may be justified.[118] In conclusion, it is safe to say that insofar as allegations of the protectionist use of cartel fines by the EC hold water (and we conclude that they do not), that would only be the case for Asian undertakings—not U.S. firms.

We thus do not find a bias against non-EU firms, but there are other, non-nationality-based reasons for the higher fines imposed on those firms. For one, throughout the fining methodology of all three Commissioners, infringements taking place in only a few Member States receive differentiated treatment, mostly to their benefit. Under Commissioner Vestager, for example, we observed that such infringements receive a 16% base amount, compared to the standard 17%. This is not entirely logical: an infringement's more limited geographic scope will already lower the fine through the 'relevant sales' variable. The local nature of the infringement then further lowers the fine when setting the base amount based on the infringement's gravity. By contrast, foreign firms active in the EU generally commit EU-wide infringements, leading to higher base amounts.[119] Similarly, the EC seems to advantage small and medium sized firms (SMEs).[120] Again, this can seem strange: fines are already proportional to sales—why further lower them for undertakings with low(er) sales? Politically though, SMEs have long been considered 'the backbone of the economy' (not only in the EU), which may explain the differentiated approach.

Beyond rejecting the protectionist hypothesis, our research shows that the EC gives fines in a remarkably small range. While the Fining Guidelines state that the base amount is set by taking 0–30% of relevant sales depending on the gravity of the infringement, the EC has over the last decade been setting the base amount at 16–17% (with outliers up to 18–19%). This is explained in part by the scope of our study, which is limited to cartel fines. Horizontal agreements are generally considered to be more harmful to competition and consumers than vertical agreements, which more often

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[118] The EC may even read this policy preference in EU legislation. *See*, by analogy, Case T-201/04, Microsoft Corp. v Comm'n, 2007, ECLI:EU:T:2007:289, para 317 (Sept. 17, 2007), where the EC argues it found Microsoft's conduct abusive based on three factors, including 'the fact that the information which Microsoft refuses to disclose to its competitors relates to interoperability in *the software industry*, a matter to which the Community legislature attaches particular importance' (own emphasis).

[119] At some point, the fact an infringement went beyond the EEA's borders was also taken into account, which is more likely for foreign companies. Inexplicably, Commissioner Vestager actually set lower base amounts (16% instead of 17%) for infringements that went beyond the EEA, perhaps to pre-empt international double jeopardy.

[120] This is reflected in those trees where the magnitude of sales plays a role. *See*, *e.g.*, the entry fee under Commissioner Almunia and the base amount under Commissioner Vestager.

engender efficiencies. A quick examination of EC decisions on vertical agreements shows that its fining policy is in line with this principle.[121] For common vertical agreements that infringe Article 101 TFEU (in particular price fixing and territorial restrictions), the EC sets the base amount at 7–8% of their relevant sales, adds no entry fee, and reduces the fine by 30–40% (exceptionally 50%) for cooperation outside of the Leniency Notice.[122] The fining methodology of other cases (e.g., pay-for-delay agreements and cases with an abuse component) is less consistent.[123] Given that in some cases no fine is imposed (e.g., in *Ice Skating Union*),[124] we can say the EC has been using slightly over half of the range put forward in the Fining Guidelines (0–16/17%). Under Commissioner Kroes, the EC came a little closer to the high end of the range, with base amounts of up to 24% of relevant sales.

At first sight, the EC's restraint in setting fines appears illogical. In its Fining Guidelines, the EC states that for '[h]orizontal price-fixing, market-sharing and output-limitation agreements', the base amount 'will generally be set at the higher end of the scale' that runs up to 30% of relevant sales.[125] However, when the EC then finds such infringements, it sets the base amount around the mid-point of the range. A possible explanation for this restraint is the appeal process. Indeed, when the base amount has been contested, the GC jurisprudence has been most interesting. In one instance, it found 18% acceptable since the amount is 'scarcely above mid-point' of the Fining Guidelines' range.[126] In another instance, the GC considered 16% acceptable since 'the percentage lies at almost the middle of the scale' and could even have been higher.[127] In yet another instance, it found 16% warranted 'since that rate is one of the lowest rates on the scale of penalties prescribed for such infringements' by the Fining Guidelines.[128] The GC even sets a minimum amount: in *Ziegler*, it held

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[121] We found those decisions by running a similar search in the EC database as described under Section II but selecting the policy area 'antitrust' rather than 'cartels'.

[122] *See* Comm'n Decision AT.40181, Philips (7% base amount, 40% reduction); Comm'n Decision AT.40182, Pioneer (8% base amount, 50% reduction); Comm'n Decision AT.40428, Guess (7% base amount, 50% reduction); Comm'n Decision AT.40432, Character Merchandise (8% base, 40% reduction); Comm'n Decision AT.40433, Film Merchandise (8% base amount, 30% reduction); Comm'n Decision AT.40436, Ancillary Sports Merchandise (8% base amount, 40% reduction); Comm'n Decision AT.40465, Asus (7% base amount, 40% reduction); Comm'n Decision AT.40469, Denon & Marantz (7% base amount, 40% reduction); Comm'n Decision AT.40528, Melia (Holiday Pricing) (7% base amount, 30% reduction).

[123] In pay-for-delay cases, for example, the EC sets a lump sum fine with reference to Fining Guidelines, *supra* note 3, para 37.

[124] Comm'n Decision AT.40208, International Skating Union's Eligibility Rules.

[125] Fining Guidelines, *supra* note 3, para 23.

[126] Case T-104/13, Toshiba Corp. v. Comm'n, 2015, ECLI:EU:T:2015:610, para 192 (Sep. 9, 2015).

[127] Case T-264/12, UTi Worldwide, Inc. v. Comm'n, 2016, ECLI:EU:T:2016:112, paras 281 and 288 (Feb. 29, 2016).

[128] Case C-99/17, Infineon Tech. v. Comm'n, 2018, ECLI:EU:C:2018:773, para 210 (Sep. 26, 2018); *see also* C-637/13, Laufen v. Comm'n, 2017, ECLI:EU:C:2017:51, para 65 (Jan. 26, 2017) for a similar reasoning regarding a 15% base amount.

that—in accordance with the Fining Guidelines—'for the most harmful restrictions, the rate should, at the very least, be above 15%.'[129] It continues: 'Where the Commission simply applies a rate equal or almost equal to the minimum rate laid down for the most serious restrictions, it is not necessary to take into account additional factors or circumstances. That would be required only if a higher rate had to be established.'[130] In short, staying around the mid-point of the range limits the EC's duty to state reasons and thus safeguards its decision on appeal.

However, while staying within this narrow range is clearly safe, it is not necessarily good policy.[131] This study does not concern the effectiveness of antitrust fines, so our conclusions on this point must remain modest. But, with the effective deterrence of cartels in mind, the EC decided to adopt a policy of setting fines at the higher end of the 0–30% range.[132] If the EC's view on cartel fines changed, it should be explicit about adopting a new policy; if its view did not change, the EC should follow its stated policy (also from the perspective of legal certainty). In any case, given the case-specific nature of antitrust law, one would expect different cases to elicit different enforcement responses when optimizing for a specific goal (deterrence). Immunity from GC annulment or adjustment does not seem like a good enough reason for not following the Fining Guidelines. Put simply: we believe the EC can and should be bolder in setting cartel fines' base amount.

At the same time, the GC should assess EC fines based on a more explicit framework. The European Court of Justice (ECJ) has repeatedly held that the EC limited its own jurisdiction by issuing the Fining Guidelines.[133] Additionally, the EC can only deviate from its fining policy in an individual case if they put forward the reasoning to do so.[134] At present, a base amount set in the middle of the Fining Guidelines' range is considered a sufficient explanation. However, deviations should not simply be assessed by reference to the EC's self-imposed limits, but also in comparison with previous fining decisions. Take an 18% base amount: this would fall in the mid-range under Commissioner Kroes, fall in the upper-range under Commissioner Almunia, and would be exceptionally high under Commissioner Vestager. Thus, while the amount would be 'scarcely above mid-point' of the Fining

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[129] Case T-199/08, Ziegler SA v. Comm'n, 2011, ECLI:EU:T:2011:285, para 141 (June 16, 2011).

[130] *Id.* para 142.

[131] The EC confirms in its Fining Guidelines, *supra* note 3, para 23 that setting fines for cartels at the high end of the range is indeed 'a matter of policy'.

[132] On deterrence, *see id.* para 4 ('Fines should have a sufficiently deterrent effect').

[133] Joined Cases 189, 202, 205, 208, & 213/02, Dansk Rørindustri v. Comm'n, 2005, ECLI:EU:C:2005:408, para 209 (June 28, 2005); Case T-758/14, Infineon Tech. v. Comm'n, 2020, ECLI:EU:T:2020:307, para 150 (July 8, 2020), also referencing the unpublished Case C-70/12 P Quinn Barlo Ltd. v. Comm'n, 2013, ECLI:EU:C:2013:351, para 53 (May 30, 2013).

[134] Case T-758/14, Infineon Tech. v. Comm'n, 2020, ECLI:EU:T:2020:307, para 150 (July 8, 2020).

Guidelines' range, it would be a significant deviation from the EC's actual fining policy (depending on how far back in time one goes). Of course, the deviation may be justified. The GC rejects pleas arguing the EC had never applied variables or increases up until the appellants' case.[135] And as mentioned before, past decisions are no 'legal framework' for assessment.[136] Nonetheless, the EC's justification for particular amounts should be scrutinized more closely, in line with the scrutiny of relevant sales (discussed below).

Scrutiny of EC fines is particularly important in view of the equality between parties. It seems difficult to justify setting different fines (in particular base amounts and entry fees) for similar infringements. Of course, until now, it was difficult even to *know* whether there was a deviation from established EC fining policy in a specific case. That difficulty is now alleviated by the fining formula and—to a lesser extent— the doctrinal analysis set out in this article. To give one example, let us return to the *Infineon* case mentioned in the introduction. The 2018 ECJ judgement made two statements about specific values of the fining calculation: (i) a 16% base amount is at the lower end of the scale; and (ii) a 20% mitigating circumstances decrease might be insufficient to take limited contacts into account.[137] The first statement is clearly true. The Vestager-led DG COMP sets the base amount at its lowest at 16%.[138] The second statement seems untrue. In most cases of mitigating circumstances for limited involvement, parties receive a 5–10% decrease. The 20% decrease for limited involvement was *already* the highest decrease in its category. In 2020, the GC judged the case once more. Following the ECJ, it rejected the claim that the 16% base amount was unlawful.[139] However, the GC did grant an additional 5% decrease for mitigating circumstances since it found the 20% decrease insufficient.[140] The facts of the case are such that Infineon was less involved in the infringement, which is why a lower fine compared to other cartel members could be appropriate. However, other undertakings were in a similar position and received more limited decreases. There is only one firm who also received the 20% decrease after 2014, i.e., Compañía Sudamericana de Vapores in *Maritime Carriers* (2017).[141] Similarly to Infineon, the undertaking was not active in some subset of the cartelized product market. However, this non-activity is already reflected in the relevant sales, which means the

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[135] Case T-240/17, Campine v. Comm'n, 2019, ECLI:EU:T:2019:778, para 370 (Nov. 7, 2019).

[136] Case T-655/11, FSL Holdings et al. v. Comm'n, 2015, ECLI:EU:T:2015:383, paras 551–52 (June 16, 2015), referencing Case C-167/04 P, JCB Service v. Comm'n, 2006, ECLI:EU:C:2006:594, para 205 (Sep. 21, 2006).

[137] Case C-99/17, Infineon Technologies v. Comm'n, 2018, ECLI:EU:C:2018:773, paras 210-11 (Sep. 26, 2018).

[138] There is a single exception: Comm'n Decision AT.40018, Car Battery Recycling (15% base amount).

[139] Case T-758/14 RENV, Infineon Technologies v. Comm'n, 2020, ECLI:EU:T:2020:307, para 158.

[140] *Id.* para 198.

[141] Comm'n Decision AT.40009, Maritime Car Carriers, para 119.

fine already takes account of this different level of involvement when setting the base amount. Increased GC scrutiny is welcome but should be particularly sensitive to equality not just between parties *in the same decision*, but also to equal treatment *over time* (all the while leaving enough room for justified policy adjustments).

While a plea on mitigating circumstances before the GC can clearly decrease the fine, the magnitude of relevant sales is the most important factor in a fining decision. That amount attests for ~65% of the final fine (a figure taken from the best model fitted directly to Commissioner Vestager's final fines), compared to the model's ~98% accuracy rate. Unsurprisingly then, contesting the relevant sales appears to be the most effective plea to lower fines on appeal. There are two main ways to lower the relevant sales and thus the overall fine. Firstly, one can directly show that part of the sales taken into account for setting the fine are not 'tainted' sales. The reason that sales wrongly ended up in the calculation (even if the fault lies with the undertaking, which communicated bad data) does not make a difference.[142] Secondly, one can contest the EC's determination of the cartel's duration.[143] Breaking up a 'continuous' infringement by questioning certain pieces of time-period connecting evidence also reduces the duration multiplicator applied.[144]
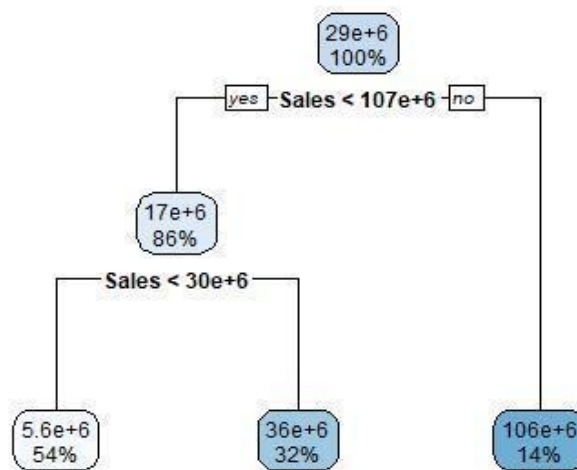

Figure XII: Sales split fines in three ranges that already account for half of the final fine prediction

'Sales' represents the magnitude of sales (e represents 10 and +6 represents the sixth power) (R2 on test set 0,568553; R2 on complete set 0,678489; variable sector not included; train control CV; seed 101)

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[142] Case T-91/11, InnoLux Corp. v Comm'n, 2014, ECLI:EU:T:2014:92, paras 170-73 (Feb. 27, 2014).
[143] Case T-104/13, Toshiba v Comm'n, 2015, ECLI:EU:T:2015:610 (Sept. 9, 2015).
[144] Case T-180/15, Icap v Comm'n, 2017, ECLI:EU:T:2017:795 (Nov. 10, 2017).

Even if sales are the more strategic plea, more targeted appeals are now possible. Currently, there is some discrepancy between the European courts' insistence on a clear explanation for the relevant sales and the infringement's duration, compared to its relatively lenient assessment of the base amount and entry fee. In *HSBC*, for example, the GC adjusted the fine since the EC had used a very specific variable to calculate relevant sales without sufficient explanation.[145] The cartelized financial product did not have any sales in the usual sense. Therefore, the EC approximated and used a 98,849% variable in the process. The GC took issue with this highly specific number since the decision itself only explained the variable had to be at least above 97%, although the EC could explain the number during proceedings. This contrasts clearly with the 16-18% base amount that is accepted formulaically. Then again, this difference may be explained by the fact that the EC plays it more safely when setting the base amount, as we discussed above.

V. Conclusion

In this article, we have significantly clarified the EC's fining methodology for cartel fines, uncovering both the variables actually used in the fining process and their specific amounts. We have done for fines given under three different Commissioners (Kroes, Almunia, Vestager), which accounts for the period 2006-20. All fines were given based on the most recent Fining Guidelines, which were adopted in 2006 but did not apply immediately to all fining decisions.

Our method mixed the computational with the doctrinal. The choice between the two depended on whether there were enough instances to assess a certain step in the fining process quantitatively. This was always the case for the base amount and the entry fee, which are set in every single decision. It proved more difficult for the mitigating and aggravating circumstances, and the increase for deterrence. Given that these factors feature only occasionally in fining decisions, we generally fell back on a closer doctrinal look to study the EC's fine-setting process.

The different methodologies are reflected in different results. We found that the EC sets the base amount—and entry fee—in a very narrow range (generally of 16–18%), especially when compared to the range put forward in the Fining Guidelines (0–30%). Given the object of our study, which focused on cartels, including price fixing and market allocation, one would expect—perhaps even hope for—a better use of the upper end of the Fining Guidelines' range. By contrast, when it comes to adjustments for mitigating/aggravating circumstances and deterrence, the results are less clear-

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[145] Case T-105/17, HSBC Holdings v Comm'n, 2019, ECLI:EU:T:2019:675 (Sept. 24, 2019).

cut. The EC uses a wider range and seemingly with less consistency, at least based on the variables we checked for. Nevertheless, our results on this front can be guiding.

It is worth repeating that we did not find evidence of anti-U.S. bias in the EC's cartel fining policy. If anything, there are potential signs of a bias against Asian undertakings. A more in-depth look at the cases in question allowed us to qualitatively dismiss these signs of bias. However, given that we did not include a variable to tease out such bias specifically (i.e., a variable for Asian companies), we cannot make any quantitively substantiated claims in this area.

Further research could try to quantitatively study fines given by the EC in other policy areas, in particular 'antitrust'. The EC categorizes both vertical agreements and abuses of dominance under this area. However, we're afraid that in this area there are too few fines (each with too many possible variables determining the amount) to fit a computational model to—a classic 'big p, little n'-problem.[146] Still, a quick doctrinal analysis has already revealed that for common vertical agreements that infringe Article 101 TFEU (in particular price fixing and territorial restrictions), the EC sets the base amount at 7–8% of their relevant sales, adds no entry fee, and reduces the fine by 30–40% for cooperation outside of the Leniency Notice. One of the authors of this article has also looked at fines under Article 102 TFEU, where the protectionist hypothesis rears its head most often. Some consistency is found there as well, with base amounts concentrated in the 10–11% range.[147]

Finally, the newfound transparency makes it possible to assess fining policies and their impact. New questions may focus on whether, for example, a 17% base amount really is enough to account for an EEA-wide price-fixing cartel's gravity. Future research may try to determine whether changes in the fining policy over time had any effect on deterrence, which is, after all, one of the main aims of cartel fines. In sum, we hope that this research—including the underlying data, which is openly accessible—can form a springboard to solving broader questions about the fairness and effectiveness of antitrust fines.[148]

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[146] *See* Machine Learning Mastery, https://machinelearningmastery.com/how-to-handle-big-p-little-n-p-n-in-machine-learning/ for an introduction.

[147] Bruno Van den Bosch, *Testing the Protectionist Hypothesis: Do Dominant US Undertakings Really Receive Harsher Fines from the European Commission?*, CONSUMER COMPETITION MARKET, April 25, 2021, https://law.kuleuven.be/ccm/blog/?p=82.

[148] *See* Bruno Van den Bosch, DG COMP Fining Practices, https://github.com/Bruno-Van-den-Bosch/research-DG-COMP-fining-practices.