

The deterrent effect of competition authorities' work

Literature review

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1. Executive Summary

- 1.1 Competition enforcement can have a direct effect by stopping anti-competitive behaviour and benefiting consumers in the particular market being investigated. It can also have an indirect effect by deterring anti-competitive behaviour by other firms if they believe that the competition authority is more likely to take enforcement action against them in the future. This report gives an overview of the existing theoretical and empirical evidence on the deterrent effect of competition authorities' work.
- 1.2 The Competition and Markets Authority reports annually on the direct financial benefits of its work in the areas of merger control, market studies and market investigations and competition and consumer enforcement. This impact assessment does not take into account the wider benefits of the CMA's interventions, such as their deterrent effect, and hence gives only a partial picture of the overall impact of our work and the relative impact of different tools. The main motivation for this literature review is to add to our understanding of these wider benefits that arise from the CMA's activities.
- 1.3 More specifically, we sought to answer the following questions:
 - (a) Do competition authorities' actions deter anticompetitive behaviour?
 - (b) How substantial is any such deterrent effect?
 - (c) What practical methodologies could competition authorities use to measure the deterrent effect of their work?
- 1.4 In response to the first two questions, our survey finds good evidence of the existence of a substantial deterrent effect from competition authorities' actions. However, the existing literature provides little help in answering the final question - establishing a practical methodology for assessing the likely deterrent effect of any particular enforcement action.
- 1.5 In particular, our review confirms that measuring deterrence is inherently difficult as it requires making inferences about infringements and mergers that never take place and the impact of our activities on the number of these 'latent' infringements and activities. In addition, the relationship between the observed (direct) impact and deterrent effect of competition authorities' work is not obvious: an authority may have a relatively low case load because it is not very good at detecting breaches of the law, or because it has deterred breaches of the law so effectively that not many remain to be investigated. Consequently, the literature suggests that a simple 'multiplier' approach using the direct observed impact of interventions as a base for estimating the

incremental deterrent effect of competition authorities' work is likely to be imperfect, but there is as yet an absence of alternative suggestions.

Existence and scale of the deterrent effect

- 1.6 We have identified a number of studies, mainly in relation to the impact of cartel enforcement and merger control, that attempt to assess the deterrent effect of competition authorities' work. The papers we have reviewed use a range of methodologies, from theoretical models to empirical studies and surveys, and focus on various possible measures of competition authorities' activities and deterrence.
- 1.7 These studies provide strong evidence of the *existence* of deterrence particularly in relation to cartel enforcement and merger control. Some studies have also attempted to quantify the magnitude of at least some aspects of this deterrent effect.
- 1.8 Overall, the literature suggests that the deterrent effect of competition law enforcement is significant and can be larger than its direct impact. More specifically:
 - (a) Most papers on cartel deterrence suggest that the existence of cartel enforcement and more active cartel enforcement deters anticompetitive activity. This deterrence is reflected in the formation, stability and duration of cartels as well as the overcharge associated with cartels that do form.
 - (b) Surveys estimate deterrence ratios to be between 4.6:1 and 28:1 for cartels, which imply that many more cartels are deterred for each one that is caught.
 - (c) An emerging literature suggests that high magnitudes of deterrence hold even when adjusting for the fact that unobserved and deterred cartels might share different characteristics to observed cartels. It is difficult to be conclusive as to magnitudes, but it has been estimated that at least 50% of potential cartel harm is deterred by the threat of enforcement and that this potential harm is a large multiple of the harm detected by the competition authority (ie the direct impact).
 - (d) Regarding mergers, there is likewise relatively good evidence that deterrent effects are significant and therefore that having a merger control regime in itself prevents anticompetitive mergers from being proposed (with surveys suggesting that around 4-18% of potential mergers are abandoned and 2-15% are restructured due to deterrence).

- (e) While there is some good evidence that more stringent merger control and challenging more mergers lead to a greater deterrent effect once a merger control regime is in place, the evidence is somewhat mixed and it is difficult to be conclusive, especially in relation to the impact of a more stringent regime (prohibitions vs remedies). Further, the literature does not presently support unambiguous conclusions on whether individual aspects of the merger regime affect the degree of anticompetitiveness and the number of anticompetitive mergers differently through deterrence.

Challenges in developing a methodology to assess deterrent effects

- 1.9 While the literature provides a good understanding of the existence of some deterrent effects, our review has also identified some significant gaps and limitations in the existing literature. These include the following:
- (a) While there is a broad literature on cartel deterrence (mainly focussing on price fixing) and an emerging literature on merger deterrence, there is little to no evidence on deterrence in the area of abuse of dominance or vertical agreements.
 - (b) Most studies focus on a specific measure of deterrence, such as the number of cartels (see eg survey results above) or the overcharge, as opposed to trying to estimate all avoided harm. Therefore, these studies give only a partial picture on deterrence.
 - (c) Only a few studies attempt to distinguish between the total deterrent effect of particular tools and policies (eg impact of having cartel enforcement or the introduction of leniency programmes) and the incremental impact of increased enforcement activity (eg the number of cases or budget allocated to enforcement). Developing a better understanding of the latter would allow competition authorities to estimate the deterrent effect of intervention and would help inform their prioritisation decisions.
 - (d) In addition, few studies consider whether particular features of an industry make them more or less conducive to deterrence. Relatedly, although some papers have tried to consider whether enforcement in one sector has an impact on others, it would be useful to gain a greater understanding of how far and under what conditions this is true. In addition, there is little work on which type of interventions lead to greater levels of deterrence.

- (e) Not all studies recognise the methodological challenge that the characteristics of observed activities might differ from those of undetected or deterred activities. This aspect is important because, for example, if detected cartels differ systematically in overcharge or duration, then estimates of total avoided based on observed infringements will be biased.
 - (f) While all methodological approaches have their drawbacks, authors often adopt an approach without reflecting on the advantages and disadvantages of their chosen approach for the research topic at issue.
 - (g) There are a number of UK and EU-specific studies but most studies focus on the US. While these studies can provide useful insights into other jurisdictions as well, more studies focussing on the UK and the EU would be helpful.
- 1.10 As a result of these gaps and limitations, existing research does not currently offer a comprehensive and robust methodology that competition authorities could use in practice to estimate the incremental deterrent effect of their interventions and, in particular, to assess the relative importance of different tools in deterring anticompetitive behaviour.
- 1.11 Conducting further research in the areas identified above, providing more clarity on the relative merits of different methodologies and, more generally, further work on developing practical methodologies for estimating deterrence would be helpful to better understand the overall deterrent effect of competition authorities' work and the relative importance of different tools.

2. Introduction

- 2.1 Many competition authorities, including the CMA, use imperfect but accepted methodologies for calculating the direct impact of competition policy interventions on consumers.¹ The CMA reports on this direct impact, broken down by its main areas of work, on an annual basis.² This impact assessment does not take into account the wider benefits of the CMA's interventions such as their deterrent effect - that is, the impact on the behaviour of companies and individuals that were not the addressees of the CMA's actions.³
- 2.2 Ignoring these effects may lead to an incorrect impression of the absolute and relative impact of different types of CMA work.⁴ For instance, an effective merger control regime that deters anti-competitive mergers from being contemplated in the first place may lead to small direct benefits as few if any anti-competitive mergers are proposed. Looking only at the direct effects hence underestimates the true impact of effective merger control. The same is true for competition enforcement.⁵
- 2.3 The initial purpose of this literature review was to answer the following three research questions:
- (a) Do competition authorities' actions deter anticompetitive behaviour?
 - (b) How substantial is any such deterrent effect?
 - (c) What practical methodologies could competition authorities use to measure the deterrent effect of their work?
- 2.4 In this report, we will summarise the findings from the theoretical and empirical literature on the deterrent effect of competition law enforcement, specifically those regarding cartels and mergers which are the focus of nearly all the studies we have identified.⁶ Alongside presenting these studies we also

¹ See *Guide for helping Competition Authorities assess the expected impact of their activities*, OECD (2014) and *A Guide to OFT's Impact Estimation Methods*, Office of Fair Trading (2010), as well as, in the literature, Hüschelrath & Leheyda (2010) and, with regard to *ex post* evaluation of merger decisions, Budzinski (2013).

² See eg CMA Impact Assessment 2015/16 available [here](#).

³ A related question that is not addressed here is the impact of competition law enforcement on broader economic developments, such as GDP growth or productivity. Cf. Kitzmuller & Martinez Licetti (2012), Buccirossi et al. (2013) and CMA (2015b).

⁴ Cf. Motta (2008), p. 212 and Neven & Zenger (2008). Cf. Avdasheva & Tsytsulina (2014) for an attempt to directly assess the relative value of different types of competition enforcement in the Russian metallurgy industry, finding that merger control has the greatest impact.

⁵ Cf. Harrington (2009), p. 22-36.

⁶ Our review does not cover other indirect effects, such as the impact on economic growth or wealth distribution. The CMA, the European Commission and the Netherlands Authority for Consumers and

discuss the main challenges the measurement of deterrence poses and highlight the main gaps in the literature. Mainly as a result of these gaps, answering our last research question (ie developing practical methodologies for measuring deterrence) proved unfeasible.

2.5 The remainder of this report is organised as follows:

- (a) Section 3 sets out what we mean by deterrence and outlines some key challenges in measuring deterrence.
- (b) Section 4 summarises the findings from the literature regarding cartel deterrence.
- (c) Section 5 presents studies on merger deterrence.
- (d) Section 6 discusses the issue of interdependencies between cartel enforcement and merger control and its implications for estimating deterrence.
- (e) Section 7 sets out the main gaps we have identified in the literature and suggests some potential research directions.
- (f) The appendices contain a section on the main methodologies used in the studies and some methodological issues discussed in the literature, as well as tables categorising the papers we discuss in this report.

Makets (ACM) organised an academic conference on indirect impact on 17-18 September 2015. The presentations given on that occasion are available on the [website of the European Commission](#). In July 2015 the CMA also published a report that outlines the evidence on the relationship between competition and productivity. The report is available [here](#).

3. What is deterrence and how do we measure it?

- 3.1 In this section, we first describe what we mean by deterrence, using cartel enforcement and merger control as our main examples. Then we discuss the most fundamental challenges of measuring deterrence. More detail on the methodologies used in the literature is contained in Appendix 1.

What is deterrence?

- 3.2 By deterrence, we mean the impact of the competition regime and the actions of a competition authority in preventing or reducing the severity of anticompetitive actions in contemplation or operation. This includes, for example, the impact of competition law enforcement on the number and nature of competition law infringements, and the impact of merger control on the number and nature of proposed acquisitions.⁷
- 3.3 While many aspects of the competition regime may deter anticompetitive action, this literature review focusses on cartel and merger deterrence which are the subject of the vast majority of the studies we have identified. In doing so, it is important to note that there are some important differences in how deterrence may work in practice for different types of anticompetitive activity, and that these differences are particularly stark between cartels and mergers. To illustrate this, we first explain what deterrence means in the case of cartels and mergers respectively and then draw out the main differences and similarities.

Cartel deterrence

- 3.4 Cartel deterrence is the most widely researched part of the literature on the deterrent effect of competition law enforcement. Economists have been researching crime at least since Becker (1968), and most studies of cartel deterrence are based, directly or indirectly, on Becker's work, as adapted to competition law by Landes (1983).⁸ The basic idea of these models is that firms make the decision to break the law, eg by forming cartels, just like they make any other decision: by weighing up the costs and benefits. The benefit in this case is the extra profit that comes from joining a cartel whereas the cost is the punishment, discounted by the probability of being caught. As

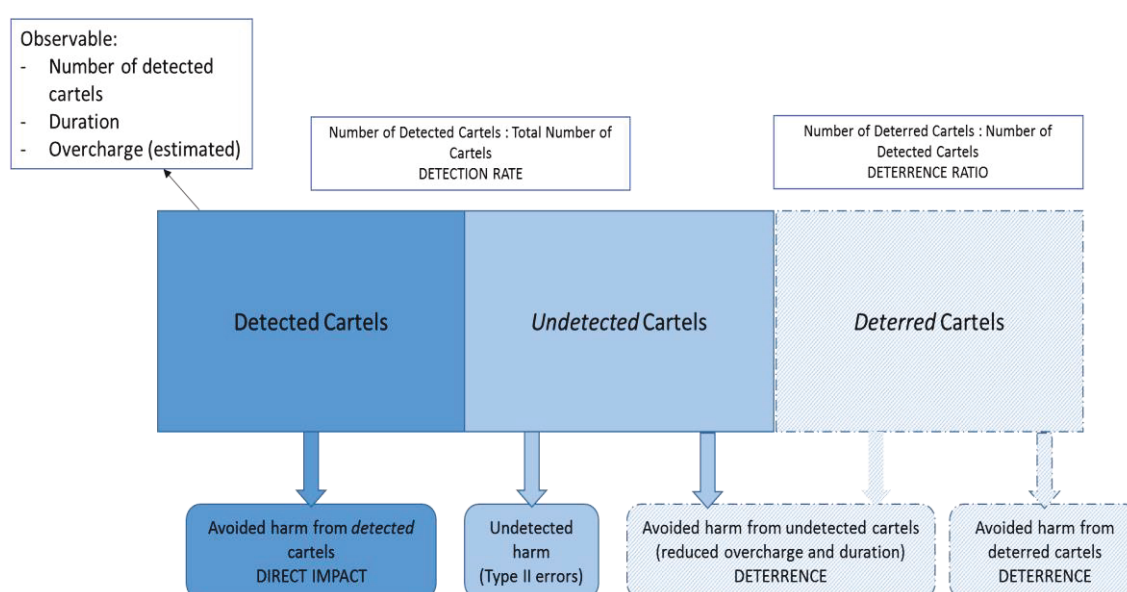
⁷ Note that some studies explicitly take into account not only the number and nature of mergers that are officially proposed, but also the number and nature of mergers that are considered – either internally or with external counsel. Eg NMa (2005).

⁸ For a useful overview of subsequent literature, cf. Buccirosi et al. (2009). For a summary of the broader literature on compliance with the law, cf. Parker & Nielsen (2007), p. 5-10.

discussed in Section 4 in more detail, competition policy can deter cartels by increasing the cost of forming and operating a cartel, or by increasing the prospect of being caught or by increasing the likely punishment if the cartel is discovered.

- 3.5 In an ideal world, a competition authority would like to be able to assess the deterrent effect of its cartel enforcement activities based on variables that are linked to the strength of its enforcement activities and are observable (eg number of detected cartels or budget/resources dedicated to the activity) or regularly estimated (the direct impact of the activity). This would allow competition authorities to take deterrence into account in their impact assessment.
- 3.6 As Figure 1 illustrates, in order to do this, one would need to understand the relationship between the direct impact of cartel enforcement and the avoided harm from deterred cartels as well as the harmfulness of undetected but undetected cartels. In other words, cartel deterrence means the impact of a competition authority's enforcement activity on the number of cartels that are created – or, in terms of Barros, Clougherty & Seldeslachts (2009, 2010), the 'frequency effect' – and on the behaviour of cartels before they are detected (the 'composition effect').

Figure 1: Cartel deterrence



Source: CMA analysis

- 3.7 Another useful framework for understanding cartel deterrence is that of Katsoulacos, Motchenkova & Ulph (2015a, 2016). They propose a dynamic model of cartel formation, detection, and prosecution, reflecting the life cycle of a cartel. This model shows that the harm done by cartels depends on (i) the rate of cartel formation; (ii) the average cartel duration; (iii) the degree to which cartels engage in harmful behaviour (overcharge); (iv) the rate of cartel detection; and (v) the rate of cartel dissolution.⁹ Each of these is affected by the others in various ways. For example, the probability of cartel detection – and the consequences if the cartel is detected – will determine whether a cartel is formed in the first place, and if it is, to what extent it will seek to exploit its market power (that is, the cartel overcharge). The challenge for the literature is to establish how exactly these variables influence each other in order to assess deterrence.
- 3.8 These two frameworks illustrate that measuring cartel deterrence, and especially all aspects of cartel deterrence, is not a straightforward exercise. At a minimum, one should take into account the number of cartels as well as the harmfulness ('composition') of cartels that never form or go undetected. This complexity explains why most of the studies we have reviewed focus only on a subset of variables when assessing deterrence, giving only a partial picture of the impact of competition authorities' work. This is discussed in detail in Section 4.

Merger deterrence

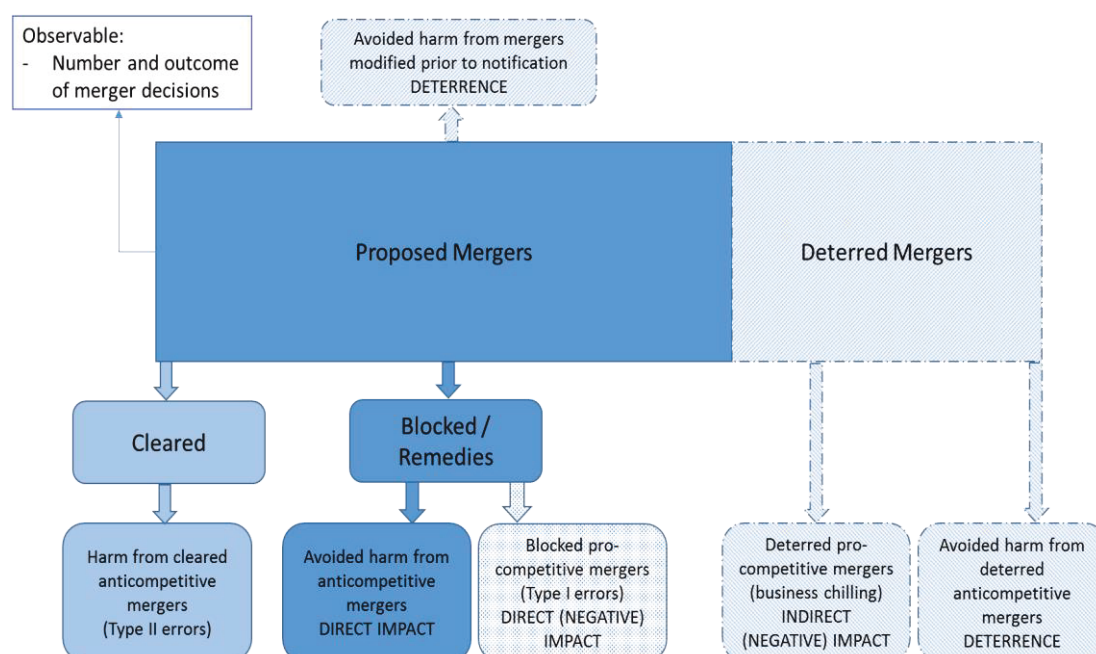
- 3.9 As with cartels, there are two ways that deterrence can improve consumer welfare with regards to mergers. The first is that enforcement may lead to fewer anticompetitive mergers. Not taking into account the potential harm from these mergers results in underestimating the impact of merger control. The second is that any such anticompetitive mergers which are proposed may be *less* anticompetitive than they would otherwise have been proposed. In the presence of Type II errors (ie the possibility that a competition authority clears an anticompetitive merger), this 'composition' effect leads to a further reduction in potential harm.¹⁰ The composition effect is also relevant in the case of any undetected mergers. However, detection is likely to be less of an

⁹ As Katsoulacos, Motchenkova & Ulph (2015, 2016) point out, most studies tend to take for granted that cartel detection will always lead to the cartel being shut down, even though this is not necessarily the case.

¹⁰ Note that in the absence of Type II errors, a competition authority would always block anticompetitive mergers (or would clear them with remedies) so that harm would be avoided and this avoided harm would be taken into account in the direct impact of the authorities' work. However, reviewing such mergers as opposed to deterring them has resource implications for the authority.

issue for mergers than for cartels, even in a voluntary notification regime such as the one in the UK. This is reflected in Figure 2 below, which focuses on the distinction between proposed and deterred mergers.

Figure 2: Merger deterrence



Source: CMA analysis

- 3.10 Figure 2 also highlights that merger deterrence may have the side effect of preventing potentially pro-competitive mergers if the competition authority makes Type I errors (ie blocks pro-competitive mergers) and this, combined with the cost and resource implications of going through a merger a review, influences business decisions.
- 3.11 The above discussion illustrates that, as for cartels, assessing all angles of merger deterrence is likely to be a challenging task. Our discussion of the relevant literature in Section 5 covers this in more detail.

Comparison between cartels and mergers

- 3.12 So far, we have discussed what deterrence means in the context of cartel enforcement and merger control respectively. In the subsequent paragraphs, we summarise some of the main differences and similarities between these two areas and also touch upon how deterrence in the context of non-cartel related competition enforcement, an area which seems to be almost completely missing from the literature, could fit into the framework we presented above. Understanding these similarities and differences can help us to interpret the studies on the different areas of deterrence and could be helpful for any future research.

- 3.13 One example of the differences between cartel and merger deterrence is that while cartels are subject to penalties where discovered, there are generally no such penalties for mergers, at least in a direct sense.¹¹ However, merging parties will incur a cost if their merger is reviewed closely by the competition authority, and failure to notify can result in great expense.¹² These reviews may both be more likely and more in-depth for more anticompetitive mergers, and may therefore be expected to influence decision-making regarding mergers in a similar way as for cartels. The severity of intervention - that is, whether an authority prohibits an anticompetitive merger or whether it clears it with remedies - can also be viewed as 'penalty' in the context of merger deterrence. Penalties should also be an important factor when considering the deterrent effect of non-cartel competition enforcement (eg abuse of dominance cases).
- 3.14 As mentioned in paragraph 3.9, a second difference is that while detection of cartels is undoubtedly challenging and hence the probability of detection is an important consideration in the cartel literature, detection of anticompetitive mergers seems less problematic.¹³ This is relatively intuitive where countries operate mandatory notification systems, and while the evidence may be slightly more mixed for voluntary systems, we may still expect higher detection probabilities than cartels. The probability of detection is an important issue when thinking about the deterrent effect of abuse of dominance cases and anticompetitive agreements not covered by the cartels literature.
- 3.15 Another important difference is the importance of Type I errors. While Type II errors (ie not detecting or not taking action against anticompetitive behaviours) are relevant for each competition tool, Type I errors (ie blocking a pro-competitive merger or penalising neutral or procompetitive behaviours) present a greater risk for merger control and non-cartel competition enforcement than for actions against hardcore cartels. In the presence of Type I errors, competition policy might deter behaviours which are not necessarily anticompetitive. In theory, the possibility of errors in decision

¹¹ Many authors in the merger deterrence literature perform their analysis without specifying what the punishment in their model is; see eg Clougherty et al. (2015), p.7. This is unfortunate because the specification of the punishment and the detection probability determines what deters anticompetitive behaviours. Without understanding this mechanisms of deterrence, it is difficult to evaluate the validity of some analyses.

¹² For the European Commission's power to impose penalties on companies that failed to notify cf. art. 14(2)(a) of Regulation 139/2004, OJ L 24, 29.1.2004, p. 1–22. Of course, both the European Commission and the CMA can impose significant additional costs on the Merger Parties by ordering an unlawful merger to be undone. Cf. art. 8(4) of Regulation 139/2004 and, for the UK, s. 35 of the Enterprise Act 2002.

¹³ Much of the literature assumes the probability of an authority not detecting an anticompetitive merger is insubstantial. Consider Joskow (2002), for example.

making should be taken into account in competition authorities' impact assessment. However, in practice, measuring these errors is very challenging and adds to the difficulties of estimating direct and indirect impact. Ex-post evaluation can be helpful in identifying some but not all of these errors in past decision making (eg one could analyse whether clearing a merger was a bad decision but it would be more challenging to assess whether a blocked merger would have been pro-competitive).

- 3.16 Despite these differences, the basic idea of deterrence is the same across cartels and mergers, and also applies to other types of competition enforcement (eg abuse of dominance). In both cases, the comprehensiveness of competition enforcement in detected cases is likely to influence both the incidence rate of anticompetitive activities ('the volume effect'), and the severity of those activities which take place ('the composition effect').

Volume effect vs composition effect

- 3.17 While the volume effect of increasingly strong enforcement is always negative, the composition effect is ambiguous. This is true for both cartels and mergers. Specifically, the effects of increasing the competition authority's activity (such as the number of investigations) may either lead to more severely anti-competitive agreements, or less severely anti-competitive agreements.
- 3.18 On the one hand, because 'stronger' merger control decreases the probability that more anti-competitive mergers are permitted, fewer may be proposed (and those that are proposed may be less severely anti-competitive). In the same way, stronger cartel enforcement may lead to cartels being less harmful as well as fewer in number: this is because more severely anti-competitive agreements should be penalised more heavily.
- 3.19 However, the opposite effect is also possible. For example, Jensen & Sørsgard (2016) show that, unless the fines schedule is carefully calibrated, enforcement can lead to less harmful cartels being deterred, while more harmful ones continue. This is because the more severely anti-competitive agreements (if permitted due to errors made by the competition authority) are more profitable, and therefore may be more worth the risk of detection. This ambiguity in relation to the composition effect should be, and in many cases is, an important consideration in the literature, adding a further layer of complexity to the measurement of deterrence.

Difficulties with measuring deterrence

Conceptual difficulties

- 3.20 A common thread in all the papers discussed in this literature review is that there are significant practical difficulties involved in estimating deterrence. After all, estimating deterrence means trying to make a statement about behaviour that never occurred by observing behaviour that was detected, which is a non-random sample of the behaviour that did occur or would have occurred.
- 3.21 Further, the data available (ie the subsample of activity which is detected) is non-random in ways that are difficult to predict. A competition authority may have a lower caseload (or similarly a caseload which contains fewer severely anticompetitive cases) because it is less effective at detecting breaches in the law, or because it has already deterred breaches of the law so effectively that few remain to be investigated. As discussed in Section 4, there have been attempts, including Davies and Ormosi (2013), to estimate the impact of these sampling biases.
- 3.22 In addition, as with any policy assessment, analysing the amount of anticompetitive activity deterred by competition authorities requires considering the counterfactual. That is, how much anticompetitive action would be undertaken in the absence of any competition law? As a hypothetical, this is very difficult to estimate.
- 3.23 The importance of this is easily seen given that there is no scope for deterrence in sectors where anticompetitive behaviour would never occur anyway.¹⁴ Competition authorities will rarely have to take enforcement action in contestable markets for example, provided that the level of barriers to entry cannot be influenced by incumbent firms.¹⁵ As set out in Section 4, the approach generally taken in the literature to address the issue of counterfactual is by considering historical cases where aspects of anticompetitive activity (by current law) were not illegal, and then making inferences to the present day.

¹⁴ Attempts to survey the degree of concentration in all industries in the economy include Pashigian (2000) and Pashigian & Self (2007). Unfortunately, their work defines an industry at the four-digit SIC level. As Werden (1988) and Pittman & Werden (1990) have shown, markets defined by four-digit SIC codes are significantly broader than the market definitions typically used in competition enforcement.

¹⁵ Cf. Hay & Kelley (1974), Fraas & Greer (1977), and Dick (1996b), as well as Asch & Seneca (1975, 1976) and the subsequent comment by Feinberg (1980).

- 3.24 Another challenge of measuring deterrence is related to the interactions between different competition policy tools. Although most of the literature focuses on the deterrent effect of a particular competition policy tool (such as cartel enforcement or merger control) in isolation, a number of studies have highlighted how the different areas of competition law enforcement are interrelated. This strand of literature is discussed in more detail in Section 7.
- 3.25 As Cosnita-Langlais & Tropeano (2013) have shown, the manner and degree of this interdependency have clear implications for the competition authority's allocation of resources and could also affect the way competition authorities should think about measuring deterrence. Their theoretical study shows that cartel enforcement and merger review are usually complementary. Since greater cartel enforcement will cause more companies to consider a merger as an alternative to collusion resulting in more potentially anticompetitive mergers, the marginal benefit to consumers from merger control increases with the resources invested in cartel enforcement.
- 3.26 At the same time, because the resources available to the competition authority are limited, investing more money in cartel enforcement will generally mean that less money is spent on merger control. However, if merger control is weakened, then companies may succeed in having potentially anti-competitive mergers approved, rather than forming a cartel. Therefore, while increasing resources on cartels *at the expense of merger control* may indeed reduce the incidence of cartels, it may not in fact reduce consumer detriment.
- 3.27 As a result, the competition authority will always spend resources on both cartel enforcement and merger review, but the balance that it strikes depends on the nature of these interdependencies. This means for example that it may not be conceptually valid to consider merger deterrence without controlling for the intensity of cartel enforcement or vice versa, although in practice doing so would be very difficult.

Differences between jurisdictions

- 3.28 A more practical challenge in assessing the literature relates to the potential issue of making inferences across different jurisdictions. As our summaries in Section 4 and Section 5 show, many empirical studies use data from the US or other non-European jurisdictions. A key question when considering the results of these studies is the extent to which eg US papers are useful for the

EU and UK enforcement practice.¹⁶ The answer depends on the extent to which the jurisdictions are similar in important ways, for example in the competition regimes' approaches and severity as well as the structure of markets and nature of firm activities.

- 3.29 Regarding enforcement action, there are important differences between the legislation in force across the US and Europe. Specifically, section 2 of the Sherman Act covering monopolisation cases has been seen as differing markedly from art. 102 TFEU and chapter II CA98 covering abuse of dominance cases (the nearest equivalent). Applications of the former are usually characterised as resulting in greater weight being placed on preserving the well-functioning of competitive processes ex-ante, and applications of the latter as placing greater burden on those firms meeting the test for dominance not to conduct their businesses in a manner restrictive for other firms. As a result, few monopolisation cases are conducted in the US which might be one of the explanation why the literature on the deterrent effect in such cases is virtually non-existent.
- 3.30 When it comes to cartel law and merger control US and European enforcement is more similar, with one important difference: in the US cartel fines and merger prohibitions are imposed only by the courts, while in Europe the primary avenue for competition law enforcement is administrative.¹⁷ This can have an implication for litigation costs and the differences in litigation costs for both the competition authority and the Parties may influence the actions of either or both entities. The effect of this on deterrence is ambiguous. In addition, there is arguably a greater focus on non-horizontal mergers in Europe when compared with the US. This would imply differences for example in the detection probabilities across different types of anticompetitive action, leading to differences in the nature of deterrence across jurisdictions. Despite these differences, US studies can be useful in understanding the mechanism of deterrence. Nevertheless, more UK and EU-specific studies would be helpful to reflect the specificities of the European regime when assessing deterrence.

¹⁶ Note that we also discuss a limited number of papers that focus on other jurisdictions still, such as Hüscherlath, Leheyda & Beschorner (2011), who consider Switzerland, and Feinberg & Park (2015), who analyse deterrence in South Korea.

¹⁷ The impact of this difference on outcomes is analysed, from a variety of perspectives, by Dewatripont & Tirole (1999), Froeb & Kobayashi (2001), Neven (2006), Bergman et al. (2011), Szücs (2012), Kovacic, Mavroidis & Neven (2014), and Dertwinkel-Kalt & Wey (2016).

4. Evidence on cartel deterrence

- 4.1 This section outlines the key findings of the literature on deterrent effects of cartel enforcement.
- 4.2 In reviewing the literature on cartel deterrence, we have tried to draw out findings from existing studies on the relationship between the strength of cartel enforcement (measured in various ways) and variables that could give some indication on the level of deterrence. A key finding from our review is that the majority of studies focus only on a subset of variables that measures deterrence, eg the number of cartels formed or the overcharge of existing cartels). As a result, many of the studies give only a partial picture of the deterrent effect of cartel enforcement. In addition, not all studies recognise the methodological challenge that the characteristics of observed cartels are likely to differ from those of undetected or deterred cartels.
- 4.3 Nevertheless, most papers suggest that cartel enforcement deters anticompetitive activity and that this deterrence is reflected in the formation, stability and duration of cartels as well as the overcharge associated with cartels that form. A small number of papers show no, or even negative effect of enforcement. However, some of these papers have some methodological limitations (see eg the discussion about stock market event studies in paragraphs 8.13-8.158.14(a) of Appendix 1).
- 4.4 In the remainder of this section, we give a detailed overview of the findings from the studies we considered while Appendix 1 discusses some methodological issues that are specific to cartel deterrence.

Measuring the deterrent effect and findings from the literature

- 4.5 As discussed in paragraph 3.4, in his classic model of crime Becker (1968) proposes that actors make the decision to break the law just like they make any other decision: by weighing up the costs and benefits. This model is the basis for most studies on cartel deterrence. In this framework, the benefit of the crime is the (financial) gain, for example the extra profit that comes from joining a cartel. The cost of the crime is the punishment, discounted by the probability of being caught.¹⁸

¹⁸ A useful survey of different estimates of the probability of cartel detection is Table 3 in the Appendix of Connor & Landes (2012), which contains 25 different estimates, ranging from “less than 0.10” to 0.33. They also sought to assess the probability of a conviction given detection, concluding that

- 4.6 Accepting this rationality assumption (as most papers do), it follows that an increase in deterrence can be achieved in one of two general ways: by increasing the punishment or by increasing the probability of being caught.¹⁹ There are several ways in which competition authorities can influence these variables.
- 4.7 First, the deterrent effect depends on there being a regime in the first place. Several papers make comparisons between sectors or time periods when cartels have been legal and those where cartels are illegal to draw conclusions as to the overall deterrent effect. Similarly, surveys often ask how much anticompetitive action would be undertaken if there were no regime. Papers addressing this question measure something akin to the ‘average’ deterrent effect of the authorities (rather than how much additional activity would be deterred by varying their enforcement intensity or penalty levels, for example).
- 4.8 Second, the probability of catching a cartel is clearly influenced by the strength of the competition regime. If the law defines cartel offences in such a way that authorities can effectively bring cases, or if the authority is sufficiently well resourced to carry out comprehensive investigations, then cartels are more likely to be detected and punished.
- 4.9 Third, the existence of a leniency scheme may increase the probability of detection. This is because key information may be transferred to a competition authority through this scheme, which may help it catch more cartels. The scheme may (as a result) also affect the stability of cartels.
- 4.10 Fourth, enforcement action in the same sector or against the same set of firms in other sectors is likely to increase the probability of detection. This may be because the authorities are able to find out about cartels in one market from investigations into a neighbouring market, or because the authority monitors activity of the firms it catches.
- 4.11 Fifth, punishments are fixed directly, and may be varied depending on the severity of the offence. In administrative systems such as the UK, the authority may set the level of punishment. However, across jurisdictions and

approximately 80% of cartels detected by the US DoJ was followed by a conviction. Cf. Connor & Landes (2012), p. 466-468.

¹⁹ In a model based on perfect rationality, both the likely punishment and the probability of being caught are common knowledge and independent from any individual enforcement action. However, if the assumption of perfect rationality is relaxed, enforcement action can impact individuals’ perception of the probability of being discovered rather than the actual probability of detection, along the lines of the model proposed by Sah (1991).

time periods, the level of penalties may vary. Further, different types of penalties are possible. In some cases, criminal penalties may be imposed, and action taken against individuals. In general, we can expect more severe punishment to increase deterrence although this may only be true up to a certain point.

4.12 In estimating the magnitude of deterrence, it is common for the literature to consider variation in the 'input' parameters which affect decisions of whether to cartelise and how much to charge. In this section, we examine in turn studies considering the effect of changes in the five parameters above on:

(a) The level of overcharge and/or price levels achieved by cartelists as well as the total harm from cartels.

(b) The duration of cartels, and relatedly, their stability.

(c) The number of cartels.

4.13 There is an element of judgement in how we have categorised the key findings, and papers which discuss more than one of these issues may be relevant to more than one section.

4.14 The literature is a mixture of theoretical and empirical papers. We discuss both in the below, including papers where no magnitudes are estimated. This is because many theoretical papers help form expectations as to the directional effects of particular actions and suggest hypotheses which can be tested. There are some papers which address questions that do not fit in our framework of looking at the input and output variables of deterrence, but which are nevertheless worth including. We discuss these at the end of the section (optimising deterrence).

Overcharge, Price Levels and Total Harm

4.15 As set out above, one of the key ways that competition enforcement may give rise to deterrence is by making cartels less severely anticompetitive. Cartelists may be incentivised to charge lower prices for fear of the cartel being detected or the higher sanctions that greater detriment entails. We organise the discussion along input parameters, as set out in paragraph 4.6.

Regime Existence

4.16 The main source of evidence here is found in papers considering legal cartels. The clearest such example takes advantage of a period of time when the US government actively sought to reduce deterrence, namely following the

enactment of the National Industrial Recovery Act (NIRA) of 1933.²⁰ The act was intended to allow prices to rise following a period of severe deflation and therefore stimulate economic recovery, although was repealed in 1935 after being declared unconstitutional by the Supreme Court.

- 4.17 Vickers & Ziebarth (2014) use data from this period and find that there was no change in price-cost margins after the NIRA was enacted, but that a variety of markers of anti-competitive conduct suggested that collusion did indeed increase: in particular, prices became less responsive to changes in cost and the dispersion of prices decreased. Data from the same period is also used to assess cartel formation and stability, as discussed below.
- 4.18 A similar approach is used in a 2003 paper by Clarke & Evenett. The authors make a comparison across countries for just a single cartel: vitamins.²¹ They hypothesise that a stricter competition regime should be reflected in a lower overcharge during the operative period of the cartel, ie before the competition laws were actually enforced against the cartel participants. Their empirical work only distinguishes between countries that actively enforced their competition laws and countries that did not (or that did not have such laws), and the paper cannot therefore imply anything about the incremental effect of making a competition regime stricter.
- 4.19 Their results support the view that competition enforcement generates significant value for consumers – for example, they find that “the annual reduction in overcharges [for vitamins] in several European nations during the 1990s was equivalent to 96% of the total cost of enforcing competition policy in those nations.”²²
- 4.20 Neither of these papers take into account the potential impact on the results of unobserved cartels, and the fact that deterred cartels may not share the same characteristics as undeterred cartels. In a rare attempt to address this, Davies, Mariuzzo & Ormosi (2017) run a Monte Carlo simulation assuming fixed distributions for the harm associated with each cartel, detection rate, and the deterrence rate, as well as making different assumptions about the relationship between these variables. Where possible, they employ results from previous empirical and theoretical studies to inform the nature of the

²⁰ Cf. also Brand (1988), Bittlingmayer (1995), Alexander (1997), and Taylor (2002). This literature is summarised more extensively in Levenstein & Suslow (2006), p. 81-83.

²¹ Another interesting case study is Bolotova, Connor & Miller (2008), a study of the US citric acid and lysine cartels. This article is not discussed here, because it lacks clear implications for deterrence.

²² Clarke & Evenett (2003), p. 725.

population distribution or the plausible range of parameters for detection probability.

- 4.21 The key result is that at least 50% of total potential anticompetitive harm from cartels is deterred by the competition authority (the authors note that it could be much higher). Further, the study suggests that the potential harm from the population of cartels which would occur without cartel law is a large multiple (the authors suggest at least 13) of the harm detected by the competition authority. This leads the authors to suggest that detected harm is “just the tip of the iceberg”.²³
- 4.22 Further, these lower bound estimates stem from the model’s results for a “weakly performing” competition authority with relatively low rates of deterrence and detection. The results suggest that strongly performing competition authorities deter over 90% of all potential harm. Interestingly, the proportion of detected harm is found to be lower for the strong authority than the weak – but this is because so much more harm is deterred. Stepping away from the precise estimates, the paper’s conclusions are clear: once one accounts for likely differences between observed and unobserved cartels, the deterrent effect is likely to be large.
- 4.23 Katsoulacos, Motchenkova and Ulph (2016) arrive at similar estimates using a different methodology. The authors build a structural model of cartel births and deaths in the presence of enforcement by a Competition Authority, in which cartels have a certain probability of being detected and shut down in any given period, but have also a probability of re-forming even after enforcement action has taken place. The model allows them to estimate the amount of harm deterred by competition authorities under different hypotheses on the values of the model parameters. Under optimistic assumptions about the fraction of cartels that re-emerge after enforcement action, they find that the fraction of total harm removed by competition authorities varies between 55 and 85%. However, this fraction drops to 28.1-58.7% if a higher probability that a cartel re-forms is assumed. The authors also find that the unmeasured deterrent effect can be large, between 1.5 and 2.9 times as large as the direct enforcement effect.
- 4.24 Overall, these results suggest that under plausible assumptions anti-cartel enforcement carries significant direct and deterrence benefits, but the amount of these benefits depends crucially on the ability of competition authorities to

²³ Davies, Mariuzzo and Ormosi (2014), p29

prevent cartels from re-forming through longer-term interventions and sustained monitoring.

Regime Characteristics

- 4.25 Warzynski (2001) analysed price-cost margins in 450 manufacturing industries in the US using 4-digit SIC codes for the period 1959-1994. He splits the period into two; before and after 1973. The rationale for splitting the sample is that attitudes towards antitrust enforcement changed over the period largely due to the influence of the Chicago school, which saw the post-war focus on market structure as too simplistic. Warzynski found that the average margin was 5 percentage points lower during the period 1958-1973, when antitrust enforcement was tougher, and suggests that firms behaved more competitively in this period.
- 4.26 Reaching a different conclusion, Smuda (2013) looks at 191 overcharge estimates in Europe from the Connor (2014) dataset. He uses parametric and semi-parametric methods to estimate the impact that different cartel characteristics and market environments had on the magnitude of overcharges. In the total sample, he finds an average overcharge of 20.7% and duration of 8.35 years.²⁴ He then splits the time period into five chronological sections with increasing anti-trust regulations. He finds no empirical evidence that more severe anti-trust legislation has an impact on the price setting of cartels.
- 4.27 This result could be consistent with there being a low deterrent effect. However, it is also possible that sample composition plays a role in this result: it may be the case that increasingly severe enforcement increases the expected penalty (either through higher fines or detection rates). As a result, even if overcharge falls across the board, only the most profitable cartels may continue to take the risk, leading to little overall effect on the average overcharge rates.²⁵ It is also important to note that, similar to many other papers on overcharge, the studies do not consider the impact of stronger enforcement on cartel duration and cartel stability.

²⁴ He finds that international cartels overcharge more than domestic ones, more experienced cartels overcharge less (experience here is having previously attempted to enter a collusive agreement) and bid rigging cartels had higher overcharges than non-bid rigging.

²⁵ For a similar argument, showing the perverse consequences of linking cartel fines to revenue, cf. Katsoulacos, Motchenkova & Ulph (2015b).

Leniency Scheme

- 4.28 In principle, many studies of leniency programmes have implications for deterrence generally. This is because leniency schemes increase detection rates, and therefore are likely to increase deterrence. Where such schemes are in operation, and therefore detection rates are purportedly higher, cartelists may find it optimal to reduce total overcharge so long as fines are proportional to previous overcharge. This is usually the case. The total amount of harm may also be lower under leniency if cartels are less stable and therefore collapse sooner –this is discussed later.²⁶
- 4.29 We discuss leniency as an independent variable when considering how changes to the design of these policies (or indeed their introduction) affects deterrence. Where changes to other policies (eg fining levels) have an effect *through* leniency on deterrence (eg Harrington 2013), we discuss these elsewhere.
- 4.30 We have found two papers, both based on laboratory experiments, which study the impact of leniency on cartel overcharge. Apesteguia, Dufwenberg & Selten (2003, 2007) conducted a lab experiment in which three policy options (including leniency) are compared to the outcomes generated by those in a one-shot Bertrand game. They found that the leniency policy they tested tended to reduce both prices and cartel formation.
- 4.31 This result was confirmed in Hinloopen & Soetevent (2008) in an experiment playing a Bertrand game with 20 iterations. They find that average prices are lower both because fewer cartels are established, and because where cartels are established, overcharge is lower.

Firm or Industry Specific Enforcement

- 4.32 There are a number of papers which consider the effect of previous enforcement action in deterring firms in the same or similar industries. At the industry level, the results are generally supportive that previous action in the sector has a deterrent effect, although many papers do not split out the direct and indirect (deterrence) effects of intervention.

²⁶ It is possible to consider another effect here: introducing leniency may lead the less profitable cartels to end sooner but may have a weaker effect on more profitable cartels (since in more profitable cartels there is more to lose for cartelists from applying for leniency). Introducing leniency schemes may therefore increase the average overcharge – although this is more of a sample composition effect since the total amount of harm would still fall.

- 4.33 Feinberg & Park (2015) study deterrence in South Korea. Using the producer price index for 288 six-digit SIC code industries as a dependent variable, and controlling for macro-economic growth and inflation, they find that prices in an industry are between 3.4% and 6.3% lower if there was an enforcement action in the previous year, but no significant effects associated with enforcement action that took place longer ago.
- 4.34 This economy-wide specification suggests enforcement action has some short-term effect on prices, but does not allow us to determine whether this is mainly driven by direct or indirect effects. To investigate this question, the authors also employ an alternative specification, using firm-level return on assets ('ROA') data instead of industry-level prices. In this specification, they estimate that enforcement action against another firm the same industry in the previous year reduces ROA by about 0.3%-points, suggesting that enforcement action has some short-term deterrent effect. However, there is no impact associated with enforcement action that dates further back.
- 4.35 Feinberg (1984) conducts a similar study focussed on nationwide manufacturing cartels in the United States, although focussed on prices rather than margins, in five other sectors. Specifically, the paper investigates whether prices for firms producing aluminium ingot, gypsum products, plumbing fixtures, concrete pipe and book matches were lower following the imposition of a penalty by the Justice Department for antitrust offences.
- 4.36 For three industries (aluminium, gypsum and concrete pipe), prices were between 6 and 12% lower following intervention, and the results were highly statistically significant. The results for plumbing and book matches were not statistically significant. For two of the three industries where a direct effect was identified, the reduction in prices persisted through time (5 years). This persistence may be suggestive of a deterrent effect (ie no re-cartelisation in the industries).
- 4.37 Lastly, Block, Nold & Sidak (1981) carried out a panel data analysis on the price-cost margin for just one product, white bread, which between 1965 and 1976 saw more price-fixing investigations by the DoJ than any other product. Using the budget of the DoJ antitrust division as a proxy for overall intensity of investigation, they found that a \$1 million increase in the budget was associated with a reduction in the margin of about 2%-points. The filing of an action in the region was associated with a further 2%-points reduction, while the direct impact in the city where the action was filed was a 4.5%-points reduction, on average. These results do not separate out the direct and indirect effects or comment on the duration of these effects

Penalties and Fines

- 4.38 Several papers have suggested that fines are too low for optimal deterrence. In particular, Smuda (2013) studies overcharge estimates in Europe and finds that in 67% of cases, ultimate punishment did not outweigh the gains from price fixing.²⁷ Further Bosch & Eckard (1991) ran an event study for 127 cartel indictments, finding that the loss of stock market value is much larger than the expected fines. They argue that this suggests shareholders are more concerned about the future fall in profits, and therefore that fines and damages are too low for optimal deterrence.²⁸
- 4.39 However, both studies do suggest that current penalty levels have at least some effect on deterrence, even if penalty levels are suboptimally calibrated.

Cartel Formation

- 4.40 Having discussed the literature regarding overcharges, we now proceed to discuss papers relating to the incidence rate of cartels. We make a distinction between the effect of antitrust enforcement on the decision to enter a cartel, and the effect on the ability of cartelists to maintain the anticompetitive agreement. This section is focussed on the former, the next on the latter. Again, we structure our discussion with relation to the 'input' category which best represents the strategy employed by the authors to measure the deterrent effect.

Regime Existence

- 4.41 Most evidence on how far the current regime deters cartelists comes from surveying relevant stakeholders, rather than through empirical data analysis. In general, there appears to be relatively consistent evidence that the existence of an antitrust authority deters a relatively substantial amount of anticompetitive activity.
- 4.42 In 2007 and 2011, the OFT commissioned consultants to carry out survey-based research into the level of deterrence imposed by the UK regime. These studies were reported as Deloitte (2007) and London Economics (2011). The Deloitte (2007) survey involved three distinct surveys:
- (a) 30 interviews with lawyers, economic consultants and companies;

²⁷ This study is discussed more fully in paragraph 4.26

²⁸ This study is discussed more fully in paragraph 4.60

- (b) A telephone survey of 234 senior competition lawyers ('legal survey'); and
- (c) A telephone survey of 202 companies ('companies survey').
- 4.43 The findings of the London Economics (2011) study, were based on:
- (a) A business survey of 809 companies ('business survey');
- (b) A behavioural experiment with 93 firm representatives ('behavioural experiment'); and
- (c) A telephone survey of 27 professionals from legal firms ('legal survey').
- 4.44 In both studies, the authors stated their key findings in terms of the number of agreements and initiatives abandoned or significantly modified relative to the number of enforcement actions taken in the same period. Comparing their results for the legal survey and the companies' survey, they found the following deterrence ratios, with the accompanying 95% confidence intervals given in brackets.²⁹

Table 1. Survey findings on cartel deterrence

	<i>Deloitte (2007) Legal Survey</i>	<i>Deloitte (2007) Companies Survey</i>	<i>London Economics (2011) Business Survey³⁰</i>
Cartels	4.6:1 (3.5-5.7)	16:1 (9-24)	28:1 (16-41)
Commercial Agreements	7.4:1 (3.9-10.9)	29:1 (17-41)	40:1 (21-58)

Source: CMA Analysis

- 4.45 Deloitte (2007) ascribed the difference between the two surveys (ie the legal survey and the companies survey) to the category of activity that was deterred without external advice being taken.³¹
- 4.46 The studies were not without flaws. In particular, Veljanovski (2014) criticised the OFT for not removing deterred pro-competitive agreements from its deterrence ratio estimates, for measuring the average deterrence rather than the incremental deterrence associated with a change in enforcement activity, for potentially capturing the impact of other competition enforcement authorities – such as the Competition Commission and the European

²⁹ Cf. Deloitte (2007), p. 56 and p. 64, and London Economics (2011), p. 7.

³⁰ These findings were limited to firms with more than 200 employees.

³¹ As an alternative explanation, they suggest that "more lawyers (on average per agreement or initiative) advise on published CA98 cases than on deterred agreement and initiatives, so that the ratios from the legal survey are underestimates". Deloitte (2007), p. 9, fn. 2.

Commission – as well as the OFT's, and for calculating deterrence ratios based on responses from individuals who had low awareness of the law.

- 4.47 Other survey evidence is also available. Van der Noll et al (2011) conducted two surveys of 97 (mostly legal) advisers and 512 Dutch companies which focused on mergers but also had some results applicable to cartels. Similar to the Deloitte (2007) study, they find evidence for the presence of deterrent effects arising from competition authority enforcement on mergers and cartels. The study estimates that on average companies have modified or terminated a negotiation on horizontal conduct about once in the last five years to prevent competition authority intervention.
- 4.48 In relation to cartel enforcement, Van der Noll et al. (2011) distinguished between cases where the conduct in question was clearly anti-competitive, and cases where the advisors reported being asked to advise on conduct where the company was uncertain. Of the 423 cases of clearly anti-competitive conduct being contemplated, 60% was deterred, 13% was started or continued and then detected, and 27% was not detected. Of the 879 cases of advice about behaviour where the company was unsure, in 39% of cases the behaviour was modified, in 32% of cases the behaviour was completely deterred, leaving only 29% of cases where the action went ahead as planned. However, among the latter there were 106 cases (12% of the total) where the advisors considered that pro-competitive agreements had been deterred by cartel legislation.
- 4.49 While the above papers are generally supportive of the idea that an authority with sufficient power can have a large deterrent effect, Schinkel & Tuinstra (2004) discuss error costs in cartel enforcement, concluding that there are also downsides. They argue that the propensity to commit errors can increase cartel formation for two main reasons. The first is that the expected sanction for law breaching decreases with errors, due to possibility of firms escaping without a penalty, even when monitored. The second is that firms that would otherwise behave perfectly competitive are induced to collude as a precautionary measure when they face the risk of being unjustly sanctioned when obeying the law. Added to this are the opportunity costs to society of resources being devoted to the competition authority, which are wasted if it is not identifying anticompetitive action effectively.
- 4.50 The overall conclusion, therefore, is that competition policy may be counter-productive in that its enforcement can stimulate, by the authority's imperfect way of policing, the very behaviour it was designed to prevent. In the extreme case, consumer welfare may be lower compared to a counterfactual without enforcement. In practice, however, it seems unlikely that a competition

authorities' propensity to make errors would be so high that this extreme scenario would materialise.

- 4.51 The paper makes clear that the worrying results would only apply to sectors which do not actually have a high tendency to cartelise, and which are not particularly well understood by competition authorities (implying higher error rates and likely also more expensive investigations). The paper cites high tech fast evolving sectors as a possible example. There is little guidance beyond the theoretical result as to how far these results apply, and in practice therefore for the purposes of this review the results best serve as a reminder that resources should be prioritised effectively to ensure the greatest deterrence.

Regime Characteristics

- 4.52 While a number of aspects of the above papers relate to this question, there are relatively few papers which consider the marginal impact of increasing regime severity.
- 4.53 Hüscherlath, Leheyda & Beschorner (2011) evaluated the changes in the Swiss competition regime in 2004 which increased the powers of the competition authority. To do so, they carried out a series of surveys and interviews, both shortly after the new regime came into force in 2005, and later, in 2008. Despite the fact that they were able to interview only very few companies and lawyers, they were able to establish a consistent link between the change in the law and reported compliance efforts. This may be expected to have a knock-on effect on cartel deterrence.

Leniency Scheme

- 4.54 The literature suggests there is good evidence that leniency schemes make forming a cartel more challenging, although there is also some evidence that the effect may be limited (or counterproductive) where competition authorities are resource constrained.
- 4.55 As noted in paragraph 4.28, Apesteguia, Dufwenberg & Selten (2003, 2007), studied the introduction of leniency schemes using lab experiment involving a one-shot Bertrand game. They found that the leniency policy they tested tended to reduce both prices and cartel formation. Hinlopen & Soetevent (2008) find support for this result, noting that the existence of a competition

authority reduces cartel formation by 50%, and the introduction of a leniency program further reduces cartel formation by 50%.³²

- 4.56 Miller (2009) devises a model to predict the pattern of cartel discoveries over time linked to a given change in the rate of detection and the rate of deterrence. Since both detection and deterrence can improve or weaken as a result of the introduction of a leniency programme, there are fundamentally four different possible patterns. Looking at the US experience, he finds that the introduction of the DoJ's leniency programme in 1993 led to an increase in cartel prosecutions in the short term, and to a drop below the pre-1993 level afterwards, suggesting that the leniency policy strengthened the deterrent effect of the DoJ cartel enforcement work.
- 4.57 As a cautionary note however, Pavlova & Shastitko (2014) show how the introduction of a leniency programme in the presence of type-I errors – ie false convictions – may lead to overdeterrence. Welfare enhancing agreements are being disbanded because the parties are worried that their collaboration will be found to be infringing after one of them applies for leniency.
- 4.58 Harrington & Chang (2012) show that the increase in caseload that follows immediately after the introduction of a leniency programme, in combination with resource constraints in enforcement, may reduce the enforcement rate of non-leniency cases enough that the net effect is an increase in cartel activity.

Firm or Industry Specific Enforcement

- 4.59 The literature considering the impact on deterrence for firms which are indicted is mixed. We begin by identifying two stock market event studies which suggest insignificant deterrence. In contrast, we then note that surveys conducted with relevant stakeholders are more supportive of there being a sector-specific effect. There is therefore a mixed picture when considering the effect of deterrence on cartel formation, although we note that the latter possibility (that sector specific effects do exist) is consistent with the findings on deterrence in terms of overcharge (see paragraph 4.32).
- 4.60 Bosch & Eckard (1991) examined the reaction of stock prices to 127 US price fixing indictments in the period 1962 – 1980. The authors find that the indicted companies had negative excess returns of 1.08% during the day of the announcement and the day before. Only 13% of these negative excessive

³² Page 612

returns could be accounted for by the direct costs of litigation, fines and damages, suggesting that part of the market value loss might reflect the present value of profits lost due to the cessation of collusive behaviour.

- 4.61 While this impact is smaller than one might have expected, the authors conclude that it is still much bigger than the expected fines and damages awards, which accounted for only 13% of the total loss of stock market value. The authors argue that shareholders are more concerned about the future fall in profits than about the fine and the damages, and that the fines and damages awards set by the courts are too low to deter future anticompetitive conduct effectively, although they do not make firms conclusions in this respect.
- 4.62 Thompson & Kaserman (2001) study stock market expectations about recidivism for individual firms by considering a large time window. They find that within roughly one year of indictment, the stock prices of 85% of the firms in their sample had returned to 100% of their pre-indictment values.³³ This result controls for the expected (CAPM-based) return during the period. They conclude that enforcement action “has very little lasting effect on market outcomes”, and “does not effectively deter collusion on any sort of sustained basis”.
- 4.63 As foreshadowed, the evidence from other sources is more mixed. In particular, the results of surveys conducted with relevant stakeholders in the UK suggests there may be at least some sector-specific effect.³⁴ In particular, when taken together Deloitte (2007) and London Economics (2011) find that a majority of lawyers surveyed considered that CA98 decisions have a greater deterrent effect against anti-competitive practices in the same sector than other sectors.
- 4.64 Deloitte (2007) further finds that, in the relatively small number of instances where firms were able to identify a CA98 decision that had had an effect on their commercial behaviour, they tended to be in the sector in question. The 2011 study found that the incidence of behavioural change linked to specific cases was too small to allow a conclusion.

³³ This paper uses the same dataset as Bosch & Eckhard (1991), although drops 5 companies that were subsequently acquitted

³⁴ Cf. Deloitte (2007), p. 9 and London Economics (2011), p. 10

Penalties and Fines

- 4.65 The Van der Noll et al (2011)³⁵ and Van der Noll (2015) survey of business and advisers finds that the level of fines is a very important factor in deterring would-be cartelists from engaging in anticompetitive behaviour.³⁶ In particular, they find that a personal fine had the largest deterrent impact of any of the policies tested. It increased the probability of compliance by 13 percentage points. A large fine for the company had an effect that was only half as large.
- 4.66 Similarly, the Deloitte (2007) survey found that the highest deterrent value is attached to criminal penalties and director disqualification also ranked highly. Alongside London Economics (2011), the survey found that companies ranked reputational damage highly. London Economics (2011) also found financial penalties were ‘very important’ for deterrence.

Cartel Duration and Stability

- 4.67 The previous section set out the evidence regarding the rate of cartel formation. This section sets out the evidence on the rate of cartel collapse, which is the other main factor determining the number of cartels in existence at any given time.

Regime Existence

- 4.68 Using again the National Industrial Recovery Act as a natural experiment (introduced in paragraph 4.16), Baker (1989) considers the steel code which was adopted by the American steel manufacturers under the auspices of the National Recovery Administration. He found clear evidence that this code facilitated collusion, and moreover that this legal collusion reduced the cost of colluding in the period after the NIRA was repealed. The information exchange during the period of low enforcement facilitated ‘punishment’ and improved cartel stability when the regime returned to normal.³⁷
- 4.69 Using a different dimension of cartel legality, Dick (1996a) studies US export cartels, which are not covered by competition law.³⁸ Their legality makes

³⁵ See paragraphs 4.47 and 4.48

³⁶ The authors apply a conjoint survey methodology, whereby respondents are asked to choose between a series of two detailed alternatives Cf. chapter 6 of Van der Noll et al. (2011). This methodology is discussed further in a recent working paper by Imthorn, Kemp & Nobel (2016).

³⁷ These findings appeared to be supported for the economy in general by Alexander (1994)³⁷, although Krepps (1997) showed that her findings were due to a change in the sample composition.

³⁸ Dick studies the US, where this legality is provided for in the Webb-Pomerene Export Trade Act of 1918. For Europe and the UK, cf. the Commission Guidelines on the effect on trade concept

these cartels easier to study, and because the agreements are not enforceable in court, they may also share characteristics of domestic cartels (for example, they need to be sustainable without recourse to legal means).

- 4.70 Dick (1996a) concludes from this that earlier research has tended to overstate the stability of contracts; the frequency with which firms reorganise after early attempts to collude; and the propensity of cartels to learn from experience or age.³⁹ In any given year, less than 5% of exports were accounted for by cartelised sectors. This also has implications for cartel formation since it implies relatively low rates of cartel formation even where they are legal.

Regime Characteristics

- 4.71 Harrington (2013) offers a theoretical model that explores a company's decision to apply for leniency, given its private information about the likelihood of someone else applying or the competition authority enforcing of its own accord. He shows that when the competition authority is more aggressive in its enforcement of the law, more companies will apply for leniency (which has a knock-on effect on the stability of cartels).
- 4.72 This is true not only because a greater probability of being prosecuted makes a leniency application a more attractive option, but also because each cartel member is aware that all other participating companies will make the same calculation, making it more likely that a company will try to be the first applicant. This suggests that the introduction of a leniency programme should be combined with an increase in enforcement activity for non-leniency cases, as these changes reinforce each other for maximum deterrence.

Leniency Scheme

- 4.73 Empirical evidence on the effect of leniency on cartel stability is mixed. We have found papers which offer conclusions in opposing directions with plausible rationalisations for their results. However, a subset of the literature which focusses on multi-market firms suggests that leniency programmes are effective in reducing cartel stability in this context.
- 4.74 Hinloopen and Soetevent (2008) use a lab experiment in finding that cartel stability is lower where a leniency scheme exists. Bigoni et al. (2012) replicate

contained in Articles 81 and 82 of the Treaty, OJ [2004] C 101/81, of 27.4.2004 and the OFT Guidance on Agreements and Concerted Practices: OFT401, par. 2.24-2.27, respectively.

³⁹ He also concluded that his evidence broadly supported the drivers of collusion first highlighted by Stigler (1964). Cf. also Dick (1996b), which deals specifically with that question.

many findings in this paper using a different design, with notable differences however. In particular, introducing the possibility of self-reporting before the prices of the other players are observed to distinguish behaviour designed to protect from fines to behaviour to punish deviation, they find that cartel stability is greater under leniency. Specifically, the authors suggest that leniency schemes reduce the trust between potential cartelists after self-reporting, reducing the probability that a cartel will reform. This increases the cost of self-reporting, since it is less likely that the cartel will be able to reform later. The authors suspect that participants anticipate this, therefore reducing their willingness to self-report and improving cartel stability.⁴⁰

- 4.75 Likewise, Brenner (2005, 2009) used data on 53 cartel cases prosecuted by the European Commission following the entry into force of the 1996 Leniency Notice. In his paper, he estimated a hazard model to study the impact of leniency on cartel duration, finding no significant impact. Even where cartels spontaneously self-reported, this was usually in response to an investigation in another jurisdiction. One plausible explanation for this result is found in Gärtner & Zhou (2012), who report that it is common for leniency applicants to apply only months or years after the cartel has collapsed, contrary to what the theoretical literature would suggest.⁴¹
- 4.76 Zhou (2013), using the same natural experiment, criticises Brenner and a similar paper by De (2010) on two main points. Zhou argues his approach is more sophisticated regarding short and long run effects, and uses cross-sectional variation by including US data. He finds contrary to Brenner that that the introduction of the European Commission's leniency programme reduced cartel durations in the long run.⁴² Alongside Miller (2009), discussed in paragraph 4.56, the study is also noteworthy because it explicitly seeks to account for the fact that observed cartels are not representative for all cartels. This does mean, however, that it cannot quantify the impact on deterrence, but can only establish whether it improved or not.
- 4.77 Some literature has also focussed on how leniency programmes affect the stability of cartels when multi-product firms are involved. A particular focus of

⁴⁰ The authors speculate that this is caused by the fact that subjects anticipate "that tacit collusion or a new cartel are much less likely after a price defection including self reporting". Bigoni et al. (2012), p. 387.

⁴¹ Cf. Harrington (2013). The Gärtner & Zhou (2012) result is supported by Davies, Ormosi & Graffenberger (2015), who report that there were 36 cartels among the 128 cartels that they looked at which had already broken down before detection, and that 31 of these were detected via leniency.

⁴² Focusing on cartel duration rather than discovery is a recommendation of Harrington & Chang (2009). Discussing an earlier version of that paper, Miller (2009) argues that it is preferable to focus on cartel discovery because cartel duration is often negotiated as part of a settlement, rather than objectively measured.

the literature is on American cartels, where the DoJ's Amnesty Plus policy aims to incentivise multi-product firms to apply for leniency in all markets where they collude.

- 4.78 Lefouilli & Roux (2008, 2012) use a model to show that where two firms encounter each other in two markets,⁴³ the Amnesty Plus policy could have the perverse consequence of making cartels more stable rather than less. It would do so by preventing the firms from cheating in only one market.
- 4.79 Marx et al. (2015) analyse the policy further, using a richer model to explore the implications of the rule that companies which were proved to have colluded were permitted to take advantage of the Amnesty Plus policy *prior* to any DoJ investigation into adjacent markets but not the usual leniency policy *after* the investigation had begun. The authors concluded that, by applying for leniency in one market only – the “sacrificial cartel” – the participating companies could credibly commit not to apply for leniency in any of the other markets where they were colluding, as this was now ruled out by the DoJ’s policy.
- 4.80 While Lefouilli & Roux (2008, 2012) and Marx et al. (2015) assumed that the markets were unconnected, Choi & Gerlach (2013) modelled a situation where the two markets are for products that are complements or substitutes, where the latter case includes the case of production in different geographic markets with costly arbitrage.⁴⁴ They derive a series of results for the range of cartel fines that reduce or increase the stability of the cartel.
- 4.81 Specifically, if the products are sufficiently strong substitutes, there exists a range of fines where the firms deploy a multi-market trigger strategy in equilibrium. Competition law enforcement in one market makes this strategy impossible, with the result that the firms return to competition in both markets. Conversely, if the products are sufficiently strong complements the firms only ever collude in one market in equilibrium, and competition law enforcement in the cartelised market leads the firms to collude in the other market. The authors show that this result implies that the competition authority should extend its investigation into the adjacent market if and only if the products are neither strong substitutes nor strong complements.⁴⁵

⁴³ Cf. DoJ (2008), questions 8 and 9.

⁴⁴ Cf. Choi & Gerlach (2009), which focuses explicitly on this interpretation of the model.

⁴⁵ In the former case, extending the investigation is unnecessary, and in the latter case there will be no collusion in the adjacent market, at least not yet. Cf. Choi & Gerlach (2013), p. 1011.

Firm or Industry Specific Enforcement

- 4.82 In the context of multi-product firms, using data taken from European Commission enforcement activity between 1985 and 2014, Zhou (2015) creates a dataset of colluding behaviour, establishing when each firm joined or exited cartels in different product markets.⁴⁶ Using this data Zhou finds that enforcement deters multi-product firms from joining cartels in other markets, while increasing the rate at which they exit existing cartels. In a subsequent paper, he concluded that enforcement action in one market increases leniency applications in related markets.⁴⁷ This may be expected to have an effect on the stability of cartels.

Penalties and Fines

- 4.83 Bigoni et al. (2014, 2015), used a lab experiment to study the interaction between the impact of the leniency programme and the level of the fine, finding that low fines are undesirable because they allow firms to apply for leniency strategically, as a tool to punish cheating, thus stabilising the cartel. High fines, on the other hand, encourage cartel participants to distrust each other, thus reducing cartel stability.

Optimising deterrence

- 4.84 Some of the papers we have considered have touched on the relative importance of particular aspects of competition regimes and enforcement approaches in generating a deterrent effect. This section surveys additional points from the literature which tries to get at some of these trade-offs.

Financial versus imprisonment penalties

- 4.85 To the extent that criminal enforcement involves prison sentences as well as fines, as it does in the United Kingdom⁴⁸, the criminal regime can achieve something that other means of enforcement cannot. A few papers have considered the trade-off. How large does a fine have to be for an individual to be indifferent between the fine and a one-year prison sentence?

⁴⁶ The study is somewhat limited because it inevitably works with a relatively small number of observations – 263 observations of 126 different firms entering or exiting 112 different cartels – and because the dataset only includes observations of firm behaviour where the cartel was subsequently discovered by the European Commission.

⁴⁷ Zhou (2016).

⁴⁸ Cf. s. 190 Enterprise Act 2002 and Morgan (2010).

- 4.86 Parker & Nielsen (2008), analysing the results of the 2005 ACCC Enforcement and Compliance Survey, reported that their data did not support the proposition that Australian business people saw imprisonment as substantially more serious than the penalties already available.
- 4.87 In their comparison of public and private enforcement, which was discussed above, Lande & Davis (2010) evaluate a number of approaches to incorporating prison sentences and house arrest in their analysis, including the value of a statistical life used for regulatory purposes and in wrongful death cases, awards made by the September 11th Victims Compensation Fund, awards in wrongful imprisonment cases and estimates made in two other papers: Marvel et al. (1988) and Dau-Schmidt (1994) et al. Taking into account the other evidence, and rounding up, Lande & Davis (2010) settle on \$2 million per year for a prison sentence and \$1 million per year for house arrest.
- 4.88 After surveying this literature, Connor & Lande (2012) attempt to weigh up the evidence. They conclude that “a financial penalty against an individual has more of an impact on deterrence than a similar penalty against a corporation, and that prison time or the loss of one’s corporate position often is the equivalent of a very large financial penalty.”⁴⁹
- 4.89 Lastly, director disqualification, was introduced in the UK as far back as 1986⁵⁰ and was added to the toolkit of competition enforcement by s. 204 of the Enterprise Act 2002. However, UK competition authorities have been reluctant to use this instrument, not in the least because by law the purpose of a disqualification order is not to punish or deter, but to protect the public against unfit directors.⁵¹ As a result, we are not aware of any evidence on the deterrent impact of disqualification orders in competition enforcement. However, when Deloitte (2007) asked competition lawyers and companies to predict the potential deterrent value of disqualification orders, they were ranked second only to criminal penalties.⁵²

Penalising individuals versus companies

- 4.90 Baker (2001) surveys the US experience, noting the uniqueness of the American willingness to use criminal penalties against individuals as a means

⁴⁹ Connor & Lande (2012), p. 447.

⁵⁰ Director Disqualification Act 1986, c. 46.

⁵¹ Cf. s. 9A(3) Director Disqualification Act 1986 and par. 437 of the Explanatory Notes of the Enterprise Act 2002.

⁵² Cf. Deloitte (2007), p. 72.

of deterring antitrust violations. A useful theoretical starting point is Posner (1980),⁵³ who argued that corporate fines should generally be preferred over fines imposed on individuals, while individuals should not be sentenced to a prison term unless the optimal fine exceeded their ability to pay. While this view continues to be widely held⁵⁴, it is based on the assumption that the agency costs involved are sufficiently low.⁵⁵

- 4.91 The agency costs associated with trying to change the behaviour of corporate officers in their official capacities by fining the company are analysed further by Kobayashi (2001). He points out that enforcing through fines imposed on the company may be quite inefficient if the shareholders of the company, who ultimately bear the burden of this fine, can only transmit these incentives to the company's officers at great cost. In that case, relying on high fines would result in the company incurring agency costs that are socially inefficient. Imposing fines or prison sentences on the company's officers directly would reduce socially wasteful spending on reporting and monitoring.⁵⁶
- 4.92 However, Buccirossi and Spagnolo (2005) show, based on a series of simulations, that a carefully designed scheme that rewards whistle-blowers can act as an effective substitute to criminal sanctions.

Private versus public enforcement

- 4.93 There is evidence that deterrence is effective both when competition law is enforced by government and when enforced privately. Gordon & Squires (2008) surveyed a large number of studies. The earliest survey they singled out is Beckenstein & Gabel (1982). These authors surveyed 859 members of the Antitrust Law Section of the American Bar Association asking, amongst other things, about the drivers of deterrence in general and compliance efforts specifically. They found that practitioners were much more concerned about private enforcement than previously assumed.⁵⁷ This finding was confirmed for a small sample of Brussels-based lawyers surveyed by Feinberg (1985).
- 4.94 Sokol (2012) studied the impact of cartel enforcement in the US by conducting a survey of 234 antitrust lawyers and interviewing an additional 117 antitrust practitioners.⁵⁸ Asked about the relative importance of government

⁵³ That is, economic theory. For a discussion of perspectives from a variety of disciplines, cf. the volume edited by Beaton-Wells & Ezrachi (2011).

⁵⁴ Cf. Connor & Lande (2012), p. 436 and the sources cited there.

⁵⁵ Cf. Connor & Lande (2012), p. 437.

⁵⁶ Cf. also Buccirossi et al. (2009), p. 8-11 and the literature cited there.

⁵⁷ For useful commentary, cf. Lipson (1982).

⁵⁸ For more information on this survey, cf. Sokol (2010).

enforcement and private damages actions, 57% of relevant respondents said that clients were more concerned about government enforcement.

Summary and conclusions

- 4.95 This section has set out the evidence in the theoretical and empirical literature regarding the extent to which competition authorities' interventions against cartels have a deterrent effect. We have set out three broad ways in which enforcement can affect deterrence, namely through the level of overcharge, the formation of cartels, and the duration and stability of those cartels. We have further identified a number of different features of enforcement which may contribute to a deterrent effect.
- 4.96 We have found that papers are often somewhat constrained in their findings. It is common to focus on one particular aspect of enforcement to test another aspect of deterrence. In order to make comparisons across enforcement tools or types of deterrence, it is often necessary to consult different papers which engage in different methodologies. This makes it difficult to ensure that comparisons are robust, since authors rarely make comparable assumptions and do not always frame questions in the same way. This is a somewhat inevitable impact of looking at a topic as multifaceted as deterrence, and may lessen with time as the literature matures.
- 4.97 We have also found that the literature on the overall (average) impact on deterrence of having a competition authority is more developed than the literature that considers the incremental (marginal) impact of changing enforcement variables, such as penalty sizes or number of cases opened. We hypothesise that this is because the benefits of competition authorities' have come to be accepted, and that authors are now turning to the next logical question which is how authorities can optimise their impact. It is this question which is of greatest interest to us, however one for which the literature can at present provide only indicative suggestions.
- 4.98 As has been summarised elsewhere, we consider that the literature is suggestive of quite significant deterrent effects overall. While the exact magnitudes vary (similar surveys give ratios of between 4.6:1 and 28:1 (40:1 for commercial agreements), a good majority of papers find the effect is significant, and few present the opposite conclusion. The strength of these findings is strongest for overcharge, however is still relatively consistent across our two other dimensions of deterrence, cartel formation and duration/stability. Where papers present negative findings, these are often that magnitudes may not be as large as expected, not that they do not exist,

or that competition authorities may inadvertently deter procompetitive agreements as well as anticompetitive ones.

- 4.99 Further, an interesting and relatively new strand of literature appears to suggest that deterrent effects remain significant, even adjusting for the fact that undetected and deterred cartels may have differing characteristics to the detected cartels which form the basis of most studies. Empirically, the deterrent effect has been estimated in one paper to be 1.5-2.9 times as large as the direct effect. However, these studies necessarily rely on assumptions and the magnitudes are sensitive to how these are specified.
- 4.100 As regards the effect of individual aspects of the regime on deterrence, the findings are more mixed. We find somewhat consistent evidence that overcharge, price levels, and total harm are generally affected by each enforcement variable we identified. There is some evidence that tougher enforcement action increases deterrence. Further, leniency schemes appear to reduce overcharge, although the evidence appears to be somewhat limited in generally coming from lab experiments. The papers suggest that penalty levels may be a relevant contributor to deterrence, but that there is some evidence to suggest they are not set at the right level. In general, the literature often discusses direct effects and indirect effects together, and further work could be done to separate these out.
- 4.101 The literature suggests mixed evidence as to how individual aspects of the regime affect the number of cartels (and contributing elements). Some papers conduct rigorous empirical analysis and find that the introduction of leniency schemes had deterred anticompetitive agreements. However some papers point in the other direction, namely that individual firms are not deterred from future anticompetitive action. Still others note that errors or capacity constraints at the authorities may limit the effectiveness of the regime. Overall, we consider that there is some theoretical evidence that enforcement at the margin increases deterrence, but further work could address this question more specifically. The findings for cartel duration and stability are particularly ambiguous, and it is difficult to draw conclusions from the set of papers we have identified.
- 4.102 Overall, we conclude that the literature shows substantial deterrent effects for competition authorities. We also find that the literature surrounding the optimisation of deterrence, for example in how intensive enforcement should be, is still emerging and it may be too early to draw any firm conclusions in this respect. However, there is some evidence that theorised drivers of deterrence do have an effect at the margin, and this evidence is strongest as

regards overcharge and total harm rather than on factors specific to the number of cartels.

5. Evidence on merger deterrence

- 5.1 Having set out the literature on deterrence relating to cartels, we now discuss that relating to mergers. Many of the general observations made in the introductory sections hold here. In particular, the methodologies for assessing mergers are very similar to those used for cartels.
- 5.2 Further, concerns regarding the ability of those methodologies to produce unbiased estimates of deterrence given that characteristics of deterred mergers are not observed also hold here. We do not provide a detailed discussion on this as we are not aware of a developed literature specific to mergers on this point. However, the points made in the cartel literature about the differences in observed and unobserved behaviour should be born in mind for merger deterrence as well.
- 5.3 The focus in the merger literature is more diffuse with respect to the nature of deterrence than for cartels. As a result, we do not distinguish papers based on the 'output' of competition enforcement in this section.
- 5.4 Merger control may be expected to contribute to deterrence in a number of ways. As for cartels, effective deterrence is broadly achieved by sufficiently high detection rates and penalties. In the context of mergers, the key inputs to these determinants are slightly different from the cartels context, in large part because mergers are not illegal and often must be notified. As a result, detection is less likely to be an important issue.
- 5.5 We have identified the following hypothesised drivers of deterrence for mergers:
 - (a) First, straightforwardly, the deterrent effect of the merger control regime depends on whether such a regime exists. This sets something of a counterfactual to the analysis of deterrence.
 - (b) Second, deterrence is likely to be higher in sectors where the authorities have conducted investigations or where they have recently imposed severe remedies on a merger, than in sectors with which the authorities have not had much recent contact
 - (c) Third, deterrence can be expected to be more severe if the antitrust authorities have greater ability to reliably identify anticompetitive mergers. The authorities might be able to do this better if, for example, they have increased powers to gather information from merging parties or undertake detailed assessments for a higher proportion of cases. Relatedly, effectiveness with which authorities implement the competition regime

may be expected to increase deterrence: lower error rates and higher predictability may reduce incentives to structure an anticompetitive transaction.

- (d) Fourth, several papers consider the flexibility of the regime, specifically in whether competition authorities have access to a broad toolkit in remedying identified anticompetitive mergers – or whether they are required simply to prohibit mergers they believe to give rise to substantial detriment. Greater flexibility of the regime is found to allow more proportional outcomes, but also to reduce deterrence in the presence of error costs.
- (e) Fifth, and relatedly, the deterrent effect depends on the actual ‘penalties’ which are imposed by competition authorities. For a given sample of cases, authorities which use prohibitions more and remedies less can be characterised as imposing higher costs on anticompetitive agreements

5.6 We discuss the literature following this categorisation. In general, we find that there is at least some evidence that effective deterrence is achieved through each variable, although this is stronger for some than others. In particular, we find relatively good evidence that the existence of a merger regime does have a substantial deterrent effect, with surveys suggesting that between around 4% and 18% of mergers are deterred completely whilst 2%-15% are restructured to avoid enforcement. There is also some evidence that deterrence is increasing in the expected severity of the ‘penalty’.

5.7 We also find some evidence that merger control may deter pro-competitive mergers (or at least, mergers which are not expected to have an anti-competitive effect). The remarks related to this point are discussed at the end of the empirical section, before our overall conclusions.

Findings from the literature

5.8 We have set out the factors that are likely to affect the deterrence of anticompetitive and, potentially, pro-competitive mergers. In the remainder of this section we present the findings from the literature on these mechanisms.⁵⁹ In our discussion of the cartels literature, we were able to differentiate between papers which consider deterrence in terms of overcharge, the number of cartels, and the stability of cartels. However, we have found that there has been less strong differentiation in the mergers

⁵⁹ A summary table of the reviewed studies can be found in Appendix 2.

literature in the specific aspect of deterrence being measured. As a result, in this section we do not discuss different categories of deterrence separately, although we note where papers are specific on this point.

Regime Existence

- 5.9 In the absence of merger review, it should not be assumed that firms in all sectors would merge to monopoly. Where there are low barriers to entry, any attempt by merged firms to extract rent by raising their prices above the competitive level would simply induce more entry.⁶⁰ Even if supra-competitive prices were feasible, it is not obvious that companies would maximise profits by merging rather than colluding.⁶¹ As for cartel deterrence, there is therefore clearly an upper bound to the impact of merger deterrence. It is however not clear a priori how the merger regime performs within this limit. We set out the evidence as to this question in what follows.
- 5.10 The main approach to researching the overall effect of merger control regimes on deterrence has been through surveys. We set out the results from four key surveys in this respect here, which generally show positive evidence of a deterrent effect.
- 5.11 In 2005, the Dutch competition authority NMa commissioned TwynstraGudde to interview a number of Dutch competition attorneys and businessmen. This study allowed them to examine not only how actors take competition policy into account when designing transactions that ultimately end up notified, but also how transactions are rejected or modified at a much earlier stage because of anticipated competition authority concerns. Moreover, the study was able to describe the impact of the enactment of the Dutch competition act in 1997. Finally, the authors asked respondents to give estimates of the number of “ideas”, “initiatives”, and notified mergers handled by their firms, and the extent to which these were modified or abandoned for reasons relating to deterrence
- 5.12 The study is conservative in a number of ways. The authors found that about 50% of proposed transactions are rejected shortly after discussion with a competition attorney, and notes that some of these might have been dropped for deterrence reasons. On a cautious basis, it is assumed that deterrence played no role in the decision to drop these transactions, with their

⁶⁰ Cf. Cabral (2003)

⁶¹ Cf. Bittlingmayer (1985), Mehra (2008) and Kumar et al. (2012) for analysis of the trade-off between merging and colluding. Gowrisankaran (1999) offers a more sophisticated dynamic model of endogenous horizontal mergers. Note the potential link with cartel deterrence.

abandonment due to commercial reasons for example. The study also notes that only merger proposals which were sufficiently developed to discuss with a competition lawyer were studied: others may have been abandoned sooner in the development stage, which would not be counted in these statistics. However, the study concluded that of the transactions receiving serious attention, (ie those not initially rejected) 6% were ultimately abandoned and 12% amended before notification to the authorities.

5.13 As discussed in the section on cartel deterrence above, the OFT followed suit and commissioned Deloitte to study deterrence in the UK in 2007. Deloitte (2007) carried out three distinct surveys:

- (a) 30 interviews with lawyers, economists and companies;
- (b) A telephone survey of 234 senior competition lawyers; and
- (c) A telephone survey of 202 companies.

5.14 Regarding merger deterrence, the main finding of the second survey (of 234 senior competition lawyers) was that at least five proposed mergers were abandoned or modified on competition grounds before the OFT became aware of them for each merger blocked or modified by the competition authorities ('the 5:1 ratio').⁶² At the same time, the third survey (of 202 companies) showed that, if the decision is taken to abandon or modify a merger on competition grounds, this was done following external legal advice in only 25% of cases. This suggests a true deterrence ratio in the order of 20:1 rather than 5:1.

5.15 Due to the low number of qualifying mergers reported by respondents, the London Economics (2011) study, which we already mentioned in Section 5, did not analyse merger deterrence in detail, but it did show that out of 33 mergers reported, six mergers (18%) were abandoned and five mergers (15%) were modified on competition grounds before the OFT became aware of them.

5.16 The survey discussed in Van der Noll et al. (2011) and Baarsma et al. (2012) asked respondents of the mergers they had considered or had advised on, how many had been abandoned because they were insufficiently attractive (58% of plans discussed by companies, 32% of plans discussed by advisers),

⁶² While it is common to highlight this so-called deterrence ratio, it is not obvious what its value might be in evaluating the impact of merger enforcement in a particular year.

how many had been abandoned due to anticipated merger control concerns (5% and 4%, respectively) or modified (2% and 5%).

- 5.17 There are clearly challenges with comparing the surveys: they study different authorities, asked different questions, and together span nearly a decade. However, it seems fair to assume that the final headline deterrence metrics measured roughly the same thing: the number of mergers that are discussed in some detail with outside counsel, and that are abandoned or modified based on the feedback received. On that basis, we conclude that the surveys are quite consistent in showing positive deterrence. Further, deterrence appears to happen both via the frequency effect and the composition effect (see abandoned and modified mergers in Table 2 below).

Table 2 Summary of findings from surveys on merger deterrence

	<i>NMa (2005)</i>	<i>Deloitte (2007) legal survey/Deloitte (2007) company survey</i>	<i>London Economics (2011)</i>	<i>Van der Noll et al (2011)/ Baarsma et al. (2012)</i>
Abandoned	6%	8%/6%	18%	5%/4%
Modified	12%	7%/12%	15%	2%/5%
Total	18%	15%/18%	33%	7%/9%

Source: CMA Analysis

- 5.18 However, not all the evidence points in the same direction. We have identified one (older) survey and two empirical surveys which suggest that the deterrent effect is more ambiguous. Each paper is older than the surveys above, and none study the UK. In addition, they have some gaps and methodological weaknesses. Nevertheless, we summarise them for completeness.
- 5.19 Using an event study methodology, Eckbo (1992) finds no evidence that more anticompetitive mergers were proposed in Canada, which at the time did not have merger review laws, than in the US. Therefore, he rejects the hypothesis that merger review has material deterrence benefits.⁶³
- 5.20 Neven, Nuttall & Seabright (1993) interviewed lawyers involved in EU merger cases during the first few years of the modern EU merger review regime. They found that, while mergers were sometimes restructured in anticipation of likely Commission concerns, the respondents had not advised on any transactions that were abandoned because it was anticipated that the Commission would have concerns.⁶⁴ They noted, however, that it was likely

⁶³ While Eckbo & Wier (1985) report results for a range of period lengths before and after the event, finding significantly different results, Eckbo (1992) only reports for the longest period: -20 days to +10 days.

⁶⁴ Neven, Nuttall & Seabright (1993), p. 146-149.

that companies would abandon transactions that were obviously anticompetitive prior to seeking external legal advice.

- 5.21 Konings, Van Cayseele & Warzynski (1999, 2001) take advantage of the fact that Belgium and the Netherlands are similar economies except that Belgium introduced its modern competition law several years before the Netherlands. The study is not specific to mergers, and therefore also has implications for cartels. The authors use firm-level data on price-cost margins for a number of years and find that the introduction of a modern competition law in Belgium did not have an effect on price cost margins, and margins were always higher in the Netherlands.⁶⁵ However, the authors do not conclude that this makes the competition policy redundant, chiefly since Belgium was starting from a position of price regulation which would also have depressed margins and weakens the robustness of the results.
- 5.22 As a result, we conclude that there is evidence of a significant deterrent effect, although this evidence is mainly based on surveys where the results are likely to depend strongly on the specific survey design. At the same time, it is reassuring that multiple surveys conducted by different companies and academics point to the same direction. However, these findings need to be considered further against the deterrent effect on mergers which are not anti-competitive, as discussed in paragraphs 5.55-5.59.

Firm or Industry Specific Enforcement

- 5.23 Does merger control have a stronger deterrent effect in the sectors where the authorities have recently been active? This section sets out the evidence as to this question. We find that the results are mixed.
- 5.24 As discussed above, in 2011 London Economics conducted a survey of relevant stakeholders in industry on behalf of the OFT to understand deterrence magnitudes. The study reports that companies in sectors with merger investigations are not more knowledgeable about what features of a merger may make it more likely to be found to substantially lessen

⁶⁵ The paper also considers the impact of import penetration on industry performance, finding that in the Netherlands industries with high import penetration tended to have higher price mark-ups, while in Belgium there was no significant relationship. This is the opposite result from what one would expect. Cf. Kee & Hoekman (2003), who found no impact of competition law on industry markups, once international trade is controlled for and Levenstein, Sivadasan & Suslow (2015), who found no change in the special patterns of trade following cartel breakup.

competition. However, respondents were slightly more likely to report being knowledgeable about the OFT's role in competition enforcement.⁶⁶

- 5.25 Deloitte found that the percentage of mergers that was abandoned or modified on competition grounds rose from 12% to 30% (9 out of 30) in sectors where there had been a CC *inquiry* since 2000, with roughly the same impact in sectors with an adverse CC *finding* since 2000.
- 5.26 Crandall & Winston (2003) test whether margins are lower in sectors following a DOJ or FTC merger intervention. To do this, they carry out a simple cross-sectional analysis, comparing industry-level price-cost margins across sectors with a two-year lag to account for the fact that industries are unlikely to experience the effect of antitrust merger policy immediately. They control for the import/sales ratio, the growth of the number of firms during the previous five years and the capital/sales ratio.
- 5.27 The authors find that margins are higher following a consent decree and lower for industries where mergers have been challenged unsuccessfully by the competition authorities. The coefficients for the number of successful FTC or DOJ interventions and for the number of second requests are not significant. On the face of it, these results are somewhat contrary to what one would expect from good merger control: indeed, the authors conclude that “the regulators are not sorting out good mergers from bad ones with much accuracy”, and argue that they have not found that any positive deterrent effects exist (although they do not rule them out). However, unpacking the results further suggests a more mixed picture.
- 5.28 In a companion article, Baker (2003) points out that Crandall & Winston (2003) assume that all deterrence would be captured within the two-year lag, and also assume away any deterrent effect outside the sector. He also criticises Crandall & Winston (2003) for using price-cost margins as their dependent variable, referring to the literature discussed in Section 3. Moreover, Baker points out that the level of enforcement activity is a poor proxy for enforcement intensity, as the number of challenges made by the competition authority also depends on the number of mergers proposed and on a variety of other factors. Additionally, citing Werden (1988) and Pittman & Werden (1990), Baker (2003) criticises Crandall & Winston (2003) for using a 2-digit SIC definition of sectors, a limitation that they admit may affect the robustness of their results.

⁶⁶ London Economics (2011), p. 55-56.

- 5.29 Perhaps the most important criticism however comes from Werden (2003), who points out that the results found were broadly consistent with effective merger control as long as one assumes that the government generally challenges a merger before it takes place. In that case, a government win in court simply restores the *status quo ante* (implying that no price effect should be observed: the merger does not take place). The finding that consent decrees are associated with higher margins might imply that any negotiated remedies were inadequate, but it might also be due to merger efficiencies which reduce the firms' costs. It is therefore difficult to place much weight on the findings of this study due to difficulties interpreting the results.

Ability to Detect and Identify Anticompetitive Mergers

- 5.30 If a regime's merger control function has increased powers or ability to investigate mergers for anticompetitive aspects, it may be expected to reduce the incentives of firms to propose them in the first place. The evidence in this respect is not particularly well developed and is somewhat at odds with itself.
- 5.31 Using an event study methodology, Eckbo & Wier (1985) looked at the impact of the Hart-Scott-Rodino Act of 1976, which introduced pre-merger notification into US law, which should have increased the ability of antitrust authorities to filter anticompetitive mergers from not-anticompetitive ones.⁶⁷ They study a sample of 82 horizontal mergers, and compute results averaging across the sample. Amongst other points, they conclude that mergers challenged after the act was introduced were, on average, economically efficient. They note that whilst both the merging firms and their rivals experience positive abnormal returns from the merger announcements, only the merging firms (and not their rivals) experience negative abnormal returns following the blocking or remedying of a merger. They take this as evidence that the positive abnormal returns demonstrate to the industry that efficiencies are available, rather than signalling that a potential collusive agreement would be more sustainable post-merger (which would imply greater rent). Were the initial rise in the share price to be related to greater rent, we would expect the share price of rivals to have fallen on the merger's prohibition (if they were expected to share in this greater rent) – or not to have increased on merger announcement (if they were not expected in the theory of harm to share in the greater rent)

⁶⁷ The Hart–Scott–Rodino Antitrust Improvements Act of 1976 (Public Law 94-435). Cf. particularly 15 USC 18a.

- 5.32 Although the results of the study are interesting, there are some limitations which reduce the weight that can be placed on the results. Most importantly, few results for rival firms are statistically significant, and in the case of the merger prohibitions, they appear particularly sensitive to the event period specified. Further, the hypothesis assumes that rival firms are identified correctly, and given that SIC codes rather than antitrust markets are used, this may not be the case. In addition, the results may be consistent with truly anticompetitive mergers having been deterred from notifying in the first place, and there is relatively little discussion of this possibility.
- 5.33 Sørsgard (2009) models the basic relationship between merger deterrence and error costs.⁶⁸ Increasing the intensity of merger review – in his model by committing to review more cases – increases the deterrent effect of merger review. However, he finds that it also increases error costs; if more mergers are reviewed, the competition authority will get more assessments wrong. Where an authority gets assessments wrong, it is presumably because it cannot effectively identify anticompetitive mergers.
- 5.34 In this model, the optimal intensity of merger review is set by observing the trade-off between these factors. At the same time, because there is a nonzero probability of a Type II error, ie of the competition authority clearing an anticompetitive merger, even some clearly anticompetitive mergers are proposed (ie they are not deterred) as long as the profitability of the merger is sufficiently high.
- 5.35 Duso, Gugler & Szücs (2013) evaluated the introduction of the 2004 EU Merger Regulation, examining the probability of a discrepancy between the Commission's action and the action suggested based on an event study of the merger announcement.⁶⁹ They use a variety of methodologies, many of which use event study results as inputs. They study the accuracy of decision by classifying mergers as pro- or anti-competitive based on the impact of proposed mergers on rivals (with merger proposals that hurt rivals considered to be pro-competitive). They further conduct robustness checks by excluding all mergers which are not purely horizontal to reduce the possibility that exclusionary theories of harm confound the results. They find that there are fewer discrepancies between the stock market expectations and the authorities' conclusions for these types of mergers, suggesting that the reform may have allowed the authorities to more accurately identify anticompetitive

⁶⁸ Cf. Schinkel & Tuinstra (2004) for error costs in cartel enforcement

⁶⁹ 50 days before the event until 5 days after for merger announcements and Phase II decisions, ± 5 days for Phase I decisions.

mergers.⁷⁰ The study is broad and also offers conclusions on how the severity of penalties affects the extent to which anticompetitive pricing is expected and how far previous interventions influence the probability of anticompetitive mergers being proposed. These results are discussed in the following sections.

Flexibility of the regime

- 5.36 In this subsection, we consider the literature regarding the possibility of authorities to vary the severity of treatment for detected anticompetitive mergers. This affects upfront expectations of outcomes of merger control, and therefore may influence deterrence. We find that a more flexible regime is not always positive for the deterrent effect.
- 5.37 Salop (2013) analyses the possibility for the US DoJ or FTC to settle a merger review rather than take it to court under a range of assumptions about its access to perfect information, its litigation costs, the parties' litigation costs, and the time horizon over which it evaluates the merger. He points out, for example, that the authority may want to propose a settlement that is welfare-reducing if the harm associated with the court falsely clearing the merger is large enough. This, in turn, gives the Parties an incentive to anticipate this reasoning by proposing a merger structured to be more welfare-reducing than it otherwise would be. Salop terms this as 'anti-deterrence'.
- 5.38 However, if the agency takes into account the effect of its decisions on future merger proposals, Salop (2013) argues that the agency should always demand settlements that are slightly welfare-enhancing, in order to create sufficient deterrence in light of the possibility that the courts may erroneously clear a merger. Assuming the agency can credibly commit to following this policy, there is no anti-deterrence. One way of achieving this result is to implement a "Just Say No" policy, whereby the agency never settles. While initially this may lead to an increase in litigation, eventually it should lead to learning on the side of the courts, and therefore fewer erroneous court decisions, as well as to self-selection on the side of the Merger Parties, where no harmful mergers are ever proposed. It should be noted that Salop (2013) does not allow for a frequency effect. The number of mergers in the model is exogenous and the only impact of policy is on the composition of the merger proposals (eg the choice of the merger partner or the structure of the merger).

⁷⁰ As will be discussed below, the effect of the reform for procompetitive mergers is more ambiguous.

- 5.39 Cosnita-Langlais & Sørsgard (2014) reached very similar conclusions to Salop (2013). In the presence of a non-zero probability of any merger proposal – even the most detrimental – being cleared by the competition authority, remedies result in lower welfare compared to a system without remedies. This is because the remedies regime allows companies to propose transactions that they know to be quite harmful, secure in the knowledge that if the proposal is correctly assessed by the agency, they can agree remedies. Again, this implies that the existence of a flexible regime may lead to more anti-competitive merger proposals than would otherwise be the case, implying deterrence may be greater where antitrust authorities use remedies more sparingly or do not have this option. This must of course be weighed against the proportionality gains from a remedies system.

Severity of treatment for anticompetitive mergers

- 5.40 Unlike with cartels, proposing an anticompetitive merger does not lead to a fine or criminal penalties (unless it is not notified in a mandatory system). However, there are clear costs imposed on firms seeking to undertake anticompetitive mergers, if these are detected.
- 5.41 We survey the literature for information on the nature of those costs, and how they might impact deterrence, beginning by setting out important theoretical contributions before going on to discuss the empirical results. We find that there is general although not unequivocal evidence that stronger ‘penalties’ imply greater deterrence, assuming antitrust authorities are sufficiently accurate in their decision making. Note that in many studies discussed below the severity of a competition authority’s intervention is captured by prohibiting mergers as opposed to using remedies. In that sense, there is some overlap with the previous subsection on the impact of the flexibility of the regime. However, there the main factor was whether clearing mergers with remedies is an option in the existing regime whereas in this section the focus is on which possible interventions are used by the authority.
- 5.42 Barros, Clougherty & Seldeslachts (2009, 2010) study the impact of a policy change in favour of remedies rather than prohibitions on the number and composition (as captured by a single restrictiveness index η) of proposed mergers. Their model shows an unambiguous impact on frequency: remedies are more lenient than prohibitions, and therefore a switch from the latter to the former increases the number of mergers proposed.
- 5.43 At the same time, the Barros, Clougherty & Seldeslachts (2009, 2010) model suggests that the impact of substituting remedies for prohibitions on composition – the degree of anticompetitiveness of merger proposals – is

ambiguous. On one hand, increased use of remedies (which are modelled as less severe outcomes) means that proposing an anticompetitive merger is more attractive since the expected penalty of the anticompetitiveness being detected is lower. On the other hand, firms may be incentivised to reduce the anticompetitiveness of the merger so as to illicit a remedy rather than a prohibition. As a result, the overall effect for composition is ambiguous.

- 5.44 Because the model makes a clear prediction about the relationship between deterrence and frequency, but not between deterrence and composition, the authors argue that an empirical assessment of merger deterrence should focus on the former.⁷¹ The empirical literature has broadly followed this approach, however this may be more due to the fact it is often more practicable to do so.
- 5.45 A number of papers have provided empirical estimates of the effect on deterrence from cross-sectional variation in the severity of penalty outcomes. We discuss these in the remainder of the section, continuing with Seldeslachts, Clougherty & Barros (2009).
- 5.46 In focussing on the impact of the use of different merger policy tools, the authors take OECD data on the number of mergers notified, blocked, conditionally cleared ('negotiated settlements') and monitored to model the number of mergers notified as a function of merger activity in previous years and the use of merger policy tools in previous years.
- 5.47 The authors use the absolute number of proposed mergers in each country in each year as their dependent variable, and the lagged absolute number of proposed mergers as independent variables, alongside other control variables which are expected to influence the number of proposed mergers. They use a time-jurisdiction fixed effect specification to control for unobservable drivers of mergers, as well as a form of instrumentation for the lagged variables which may suffer from serial correlation. They find clear evidence that prohibiting more mergers results in fewer mergers being proposed – a 10% increase in the number of prohibitions is estimated to result in 1.3%-1.84% fewer mergers – while the evidence on negotiated settlements is much weaker.⁷²
- 5.48 Moreover, because they used the number of merger policy interventions in lagged form as well, they were able to study how long the deterrent effect of an intervention persists. Using this methodology, they found that blocked

⁷¹ As, indeed, they do in Seldeslachts, Clougherty & Barros (2009), albeit seemingly only for pragmatic reasons.

⁷² There is a significant impact, but only in some of the model specifications examined.

mergers lead to decreased merger notifications in subsequent periods and that negotiated settlements weakly increased future merger notifications; in other words, blocked mergers involved a deterrent effect, but negotiated settlements did not. The authors acknowledge that since some of the deterred mergers may be procompetitive, they are not able to quantify the welfare effects overall. Further, they assume that deterrence does not manifest itself in firms designing less anticompetitive mergers, justifying this by noting that an alternate structure may often not be available.

- 5.49 Clougherty et al. (2014, 2015) follow Seldeslachts, Clougherty & Barros (2009) in their approach to controlling for merger waves, however this time using data on all EU-notified mergers between 1990 and 2009. They use the absolute number of mergers as the dependent variable, and the lagged number as an independent variable (trying both one and two year lags), alongside a set of controls and industry-jurisdiction fixed effects. They find that phase I remedies have a significant deterrent effect, but no other outcomes are significant. They hypothesise that this is because the Commission has stronger bargaining power in Phase 1 than in Phase 2. Whilst mergers are in Phase 1, there is still the chance for firms to achieve a quick outcome which is often very valuable to them, whereas in Phase 2 the main threat is over prohibitions which occur very infrequently. This result is robust to further disaggregation into three time periods, and to disaggregation between high-competition and low-competition sectors.⁷³
- 5.50 The paper by Duso, Gugler & Szücs (2013) which has been discussed in previous sections also has relevance here. The authors use a more complex strategy in that they estimate the impact of various enforcement actions by the Commission on the probability of subsequently observing a procompetitive or anticompetitive merger.
- 5.51 They find that the 2004 reform to the EU merger regime caused Phase I remedies and withdrawals to have the effect that prohibitions had previously, namely of deterring anticompetitive mergers. This suggests that withdrawals are often the result of Merger Parties realising that their transaction is likely to be blocked. However, the paper is not able to test the impact of the reform as

⁷³ For low-competition sectors, the authors actually find a large and positive impact associated with phase II prohibitions, which goes to show how difficult it is to analyse the impact of prohibition decisions when they are so rare. Usefully, the authors use both the HHI and the Boone index as a measure of concentration, thus adding to the literature on the latter measure.

regards prohibitions due to there being insufficient data; this is likely to influence the conclusions of the paper.⁷⁴

- 5.52 In chapter 3 of his dissertation, Lee (2015) follows the example of Duso, Gugler & Szücs (2013) and studies whether anticompetitive mergers in particular are deterred. However, rather than assessing the anticompetitiveness of each merger by using an event study methodology, he used the approach of Gugler et al. (2001, 2003), comparing the merging firms' aggregated profit and sales differentials before and after the merger with the same differentials of the merger's industry.⁷⁵ The comparison carried out by Duso, Gugler & Yurtoglu (2010) suggests that this may be more robust. The intuition is that the competitive impact of a merger can be evaluated *ex post* by looking at the impact of the merger on profits and sales.⁷⁶ Deterrence can then be operationalised as the change in probability of observing an anticompetitive merger proposal along these measures.
- 5.53 Based on data on 1773 EU merger notifications, Lee (2015) concludes that phase 2 remedies and prohibitions have a significant deterrent effect, ie they result in fewer anticompetitive mergers being proposed in subsequent years, while there is some evidence that phase 1 remedies have a deterrent effect as well. Interestingly, there is also some evidence that phase 1 withdrawals are associated with an increase in the likelihood that anticompetitive mergers will be proposed in subsequent years.
- 5.54 All of the above papers have used data from European mergers or, if not centred on Europe, at least include it in the analysis (eg by using OECD data). Therefore, they are of primary relevance to this review. However, it is also worth including one US data study, namely, Clougherty & Seldeslachts (2012). In this paper, the authors use the share and number of horizontal and non-horizontal mergers as a dependent variable to look at the frequency and composition effect of merger control. Consistently across specifications – taking the relative share of horizontal mergers, the absolute number of horizontal mergers and the absolute number of non-horizontal mergers as a dependent variable – they find that the lagged dependent variable (and in the latter two cases the second lag) is still significant, suggesting that there are

⁷⁴ A subsequent paper co-authored by Duso notes that the methodology used in Duso, Gugler & Szücs (2013) "is unfeasible in our context due to the scale of our study". Clougherty et al. (2014), fn 4.

⁷⁵ Lee (2015) uses sales and profits data from Worldscope and SDC.

⁷⁶ A confounding point here may be if firms follow an approach modelled by Fridolfsson & Stennek (2005). Specifically, companies might find it beneficial to acquire a competitor even if that reduces profits if the alternative is that the target firm is taken over by another competitor. The authors argue that such "pre-emptive mergers" can be detected by comparing the change in profits – which would be negative – with the change in the merging parties' combined market value – which would be positive.

significant trend effects in deterrence. Among the merger policy variables, only the challenge rate⁷⁷ is a significant driver of horizontal merger activity but not of non-horizontal mergers. The investigation rate,⁷⁸ prohibition rate,⁷⁹ (authorities') court-win rate⁸⁰ and (authorities') court-loss rate⁸¹ do not tend to be significant.

Deterrence of pro-competitive mergers

- 5.55 We have so far focussed on deterrence of anti-competitive mergers. However, any review of the literature must also include the other side of the coin, specifically as to whether and how far merger control deters mergers which are not anticompetitive. The evidence in this respect suggests that while it is likely that there is non-zero deterrence of pro-competitive mergers, this is outweighed by deterrence of anticompetitive mergers. Further, as set out in Sørgaard (2009), deterrence in this respect may be a necessary cost of deterring anti-competitive mergers in the presence of imperfect information available to competition authorities.
- 5.56 Nelson & Sun (2002) suggest that delays caused by merger control (even if eventually clearance is likely) create risks for parties. These may deter pro-competitive (or not-anticompetitive) mergers. Lending empirical support to this idea, Eckbo & Wier (1985) suggest that the Hart-Scott-Rodino Act of 1976, which introduced prenotification in the US, reduced firms' incentives to merge even where such mergers would be efficient. The notification introduces delays and may communicate sensitive information (such as the existence of substantial cost savings) to rivals, both of which reduce the expected profitability of mergers.
- 5.57 In their paper discussed earlier, Duso, Gugler & Szücs (2013) find that, after the reform to the European Merger Regime, phase 1 withdrawals negatively impact the probability of a pro-competitive merger being proposed, while before the reform withdrawals tended to impact the probability of a pro-competitive merger positively. We are not aware of other papers to cross check this finding with, since few others differentiate between the pre- and post-reform period in the EUMR. However, results using data covering the period 1990–2009 in Clougherty et al (2015b) suggest that across the whole

⁷⁷ The authors define the 'challenge rate' as the percentage of FTC / DOJ investigations that resulted in antitrust action (prohibitions or remedies).

⁷⁸ The authors define the 'investigation rate' as the fraction of horizontal mergers for which the FTC / DOJ started a second-request investigation.

⁷⁹ The authors define the 'prohibition rate' as the percentage of prohibitions over the total antitrust actions;

⁸⁰ The authors define the 'court-win rate' as the fraction of cases won in court by U.S. antitrust authorities

⁸¹ The authors define the 'court-loss rate' as the fraction of cases lost in court by U.S. antitrust authorities

period, there was no deterrence of pro-competitive mergers by phase 1 remedies, but only of anti-competitive mergers.

- 5.58 In their survey of competition lawyers and businesses, Deloitte found that intervention against pro-competitive mergers was not generally considered to be a problem.⁸² In the survey of competition lawyers, the mean response was 1.80 out of 4, compared to 1.92 among the companies, where 1 means that chilling of pro-competitive mergers is ‘never’ a problem, while 4 means ‘frequently’. Clougherty et al. (2014, 2015) summarise this finding as “UK merger policy rarely deters pro-competitive merger activity.”
- 5.59 This view is supported by other surveys. Van der Noll et al. (2011) found that 9% of companies and 6% of advisors said that the chilling of pro-competitive mergers happened often or very often. Sokol (2010, 2012) found that with regard to overdeterrence that 5% of relevant respondents said that this occurred frequently, and 24% said often. However, 70% said this never happened.

Summary and conclusions

- 5.60 This section considered the available evidence linking the severity of merger control with the deterrence of anti-competitive action. The literature addressing this question appears to be less extensive than for cartels. Further, the literature is less specific with regard to the nature of the deterrent effect on frequency versus composition. Many papers seem to make the assumption that some firms will react to the foreclosure of certain merger activities by proposing different types of mergers, but others will simply react by ceasing merger activity altogether, and therefore that the frequency and composition effects go hand in hand.
- 5.61 However, this may not always be the case: whilst making merger control less severe by making remedies more achievable might encourage firms to structure transactions so as to avoid prohibitions, less severe antitrust is also likely to increase the number of proposed mergers. As a result, further work could be done to consider whether the papers which do not allow for a distinction between the frequency and composition effect could be adapted to do so, and whether the results differ depending on the specification.

⁸² Cf. Deloitte (2007), p. 44. Cf. the theoretical analysis in Davies & Ormosi (2013), p. 31-32, discussed above, and the argument by Baker (2003) that there is only limited risk of overdeterrence in merger policy because “a substantial fraction of acquisitions turn out not to be successful in obtaining the projected efficiency benefits” (p. 41).

5.62 In our review of the merger deterrence literature we have followed the same approach as in the cartels section by categorising papers discussing different enforcement ‘variables’, such as the intervention rate in particular sectors and the severity of ‘penalty’ for detected anticompetitive action. We find that the issues at play in merger control differ from those in cartels, which seems primarily due to three factors.

(a) First, there is arguably greater uncertainty as to whether a merger will be deemed anticompetitive than the formation of a cartel, given the complexities surrounding the former and the prescriptiveness of legislation concerning the latter. Factors which affect this uncertainty are therefore relevant to merger control deterrence while they are much less relevant to cartel deterrence.

(b) Second, the nature of penalties for anticompetitive mergers is quite different to the penalties for cartels. The severity of the penalty for anticompetitive action in mergers is less tightly related to the anticompetitiveness of the action. As a result, papers treat the severity of merger outcomes (prohibitions, remedies etc) differently. Some treat remedies as a less severe outcome than prohibition, whilst others do not assume any ordering in the severity of the outcomes (ie they enter the models or regressions as categorical variables). This has implications for how the studies’ results must be interpreted.

(c) Third, in contrast to cartels, changes to merger control have arguably focussed less on varying its stringency. As a result, it is harder to test empirically how a relatively more or less stringent merger control might affect deterrence.

5.63 These issues aside, we find relatively (but not uniformly) consistent evidence that the existence of a merger control regime creates a deterrent effect. As discussed in paragraph 5.17, a number of surveys suggest that between 4% and 18% of mergers are deterred completely and 2%-15% are restructured to avoid enforcement. These suggest at least some significant deterrent effect.

5.64 There are a number of papers which discuss the effects of different outcomes (eg prohibitions and remedies). They are consistent in finding significant deterrent effects of interventions, but not in whether increasing severity of outcomes leads to increased deterrence. While some papers find evidence that deterrence is increasing in the severity of the intervention, others find effects for only some of the ‘less stringent’ outcomes, such as phase 1 remedies. We consider that all these papers taken together provide overall evidence in favour of significant deterrent effects, but no consistent evidence

that particular outcomes (remedies, prohibitions etc) have greater deterrent effects than others. The theoretical literature suggests that remedies may not be as effective as prohibitions, but what empirical evidence there is appears to suggest the reverse.

- 5.65 There are several other aspects of merger control which have received attention in the literature. A few papers have considered how the regime's *flexibility* with regards to the outcomes that can be imposed (eg by introducing remedies or settlements procedures) influences deterrence. These papers find that the existence of errors on the part of courts and antitrust authorities implies that deterrence may be reduced where flexibility increases.
- 5.66 Other papers have considered intervention rates. There appears to be at least some evidence that challenging mergers (and indeed challenging *more* mergers) leads to greater deterrent effects, and that intervention in particular sectors leads to greater awareness and deterrence in those sectors as opposed to others. However, as elsewhere, the evidence is not uniform. Similar conclusions emerge from the limited evidence on regime predictability.
- 5.67 Finally, we have considered whether it is possible to draw inferences on the regime's impact on pro-competitive mergers as opposed to anti-competitive mergers. We find that the literature generally suggests that there is at least some deterrence of pro-competitive mergers, but that this is relatively infrequent and may be inevitable given authorities' non-zero propensity to commit errors. As the literature sets out, authorities are likely to face a trade-off: more in-depth reviews mean greater deterrence but also greater error costs. This is particularly true when authorities have fixed budget constraints.
- 5.68 Overall therefore, we find that there is evidence that merger control does lead to significant deterrent effects for anticompetitive mergers, even if this may sometimes come at the expense of a few procompetitive mergers. We also see some limited evidence that increasing review intensity and predictability may give rise to more deterrence. We do not see this for other aspects of the merger review regime however: in particular, there is mixed evidence on whether increasing severity of treatment for anticompetitive mergers leads to deterrent effects. All of this is based on a relatively small subset of papers.

6. Interdependencies

- 6.1 As foreshadowed in the introductory section, there are a number of ways in which cartel enforcement action and merger control interact. Specifically, more intense cartel enforcement may incentivise more potential cartelists to seek mergers (and vice-versa).⁸³ As a result, the analysis above which holds constant the stringency of merger review when discussing the drivers of cartelisation (and vice-versa), may be somewhat incomplete.
- 6.2 There is an interesting body of literature which engages with this issue. It is of particular interest for a competition authority, given that the results may have implications for how budget is prioritised between departments. We engage with this literature in the following way.
- 6.3 First, we consider how more effective cartel deterrence affects merger deterrence. Second, we consider how more effective merger deterrence affects cartel deterrence. Finally, we add some reflections as to how both may interact with abuse of dominance legislation, although note that the literature in this respect is not well developed.

How does effective cartel deterrence influence merger rates?

- 6.4 We set out a number of key papers which discuss this issue. The overall finding is that increasing cartel deterrence leads more firms to try and merge, and therefore the overall deterrent effect for anticompetitive activity may be overstated when the issues are considered separately.
- 6.5 Bittlingmayer (1985) considers whether stricter cartel enforcement leads to more mergers. In doing so, he provides a detailed case study of the first judgements of the US Supreme Court after the enactment of the Sherman Act in 1890, showing that the Court's judgements were widely interpreted as opening the door to a strict enforcement of cartel laws but a much more lenient system of merger review. He argues that this was one of the major factors driving the merger wave of 1898-1902. He supports this conclusion with analysis of specific industries where cartel enforcement seemed to encourage merger activity.⁸⁴
- 6.6 Support for this conclusion is found in the analysis of data on European Commission enforcement practice by Hüscherlath & Smuda (2013) and

⁸³ For a theoretical study of a firm's choice between cartel and merger, cf. Mehra (2008) and Kumar et al. (2012, 2014).

⁸⁴ Cf. also Lamoreaux (1985), Mueller (1996a, 1996b), Kumar et al. (2012).

Davies, Ormosi & Graffenberger (2015). Both papers show that cartel breakdowns are typically followed by intensive merger activity, suggesting that if cartel enforcement makes it difficult to set prices jointly, companies will seek out other means to achieve this end.

- 6.7 Specifically, Hüschelrath & Smuda (2013) find that the number of horizontal mergers is 83% higher in the 3 years after cartel breakdown than in the 3 years before, although the increase is lower if the geographical scope of the analysis is restricted or if non-horizontal mergers are included as well. The latter, however, could be explained by the fact that non-horizontal mergers are not likely to be alternatives for cartel activity from a strategic point of view.⁸⁵ Table 4 below summarises the authors' estimates for the effects of anti-cartel action on merger creation.

Table 3: Average number of mergers before and after cartel breakdown

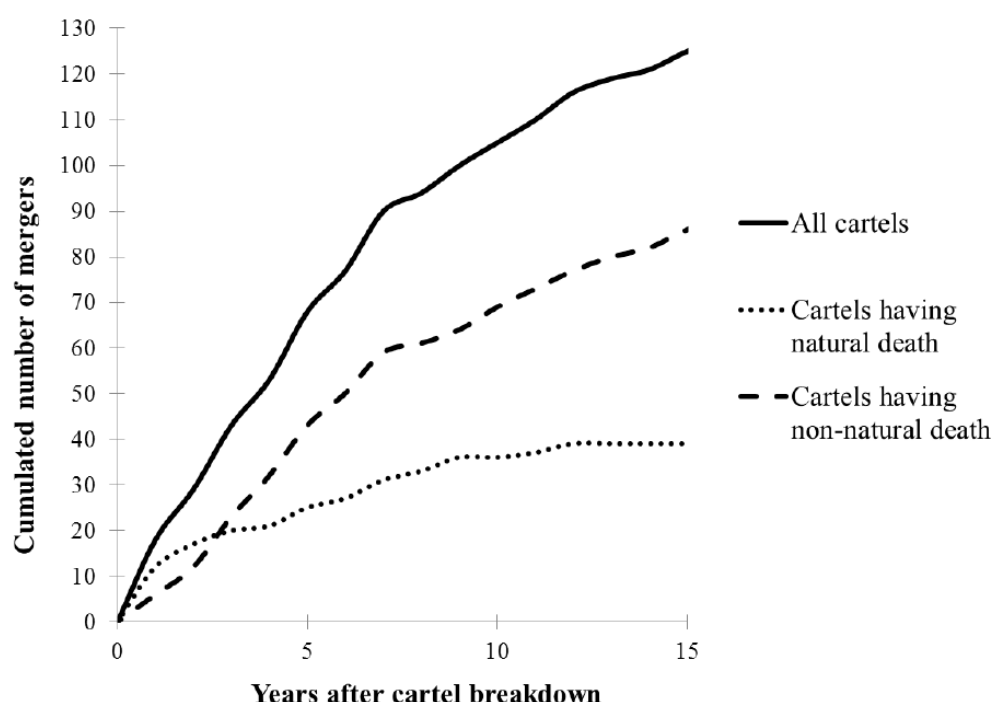
	<i>All mergers</i>			<i>Horizontal Mergers</i>		
	<i>3 years before cartel breakdown</i>	<i>3 years after cartel breakdown</i>	<i>% change</i>	<i>3 years before cartel breakdown</i>	<i>3 years after cartel breakdown</i>	<i>% change</i>
Worldwide	696	1052	+51.2	196	359	+83.2
At least one merging firm stems from EEA	414	522	+25.1	129	188	+45.7
Both merging firms stem from EEA	275	351	+27.6	76	126	+65.8

Source: Hüschelrath & Smuda (2013), p. 424, Table IV

- 6.8 Davies, Ormosi & Graffenberger (2015) confirm this result using a longer time period and a different econometric specification. Using a dataset of 84 cartels detected by the European commission between 1984 and 2009 involving a total of 593 firms, they find that around half of these cartels were followed by one or more mergers between the previous cartelists, observing a total of 128 qualifying mergers after cartel breakdown. They investigate both cartels with natural deaths and those discovered by the competition authority, for example through leniency. Looking at the data over time, without controlling for the number of mergers that might be expected absent the cartel breakdown, they found the following trend in mergers over time:

⁸⁵ Table IV on p. 424 of Hüschelrath & Smuda (2013).

Figure 3 Cumulated number of mergers after cartel breakdown



Source: Davies, Ormosi & G zraffenberger (2015)

- 6.9 In the graph, it is evident that the merger activity is most intense in the early period after cartel breakdown: 50% of the 128 mergers occurred within the first 54 months. This implies an unusually high number of mergers per firm (0.02 per annum) compared to the average long-term number of mergers per firm in the UK (0.007 per annum), suggesting that the anti-cartel enforcement may have significant spillovers on the number of mergers being proposed.
- 6.10 They caution that some of the post-breakdown mergers are likely be efficient and not an attempt to regain some of the cartel's rents). This is because lower prices post-breakdown will cause less efficient firms to exit the market, and part of the way they may do this is through acquisition. In order to provide comment on how common this alternative, unproblematic, explanation occurs relative to the anticompetitive explanation, they apply two screens to the mergers. First, they ask how frequently mergers lead to market structures that might cause a competition authority concern on a coordinated theory of harm. Second, they use an event study considering whether the merger leads to a rise in the valuations of both acquirer and rivals. They find that the coordinated (anticompetitive) explanation holds in "at least a large minority of cases".
- 6.11 Similar results are found in Marx & Zhou (2015). The authors take a similar approach with some significant changes. These include using a longer time

period; treating multiple products covered by a European Commission decision as different cartels; considering mergers taking place before cartel dissolution; focussing on leniency applications using the date of the introduction of leniency to account for the program's effect on incentives even for cartels investigated before the policy was introduced, and altering the econometric specification.

- 6.12 Similar to the findings for cartel breakdown in Davies, Ormosi & Graffenberger (2015), Marx & Zhou (2015) find that the EC's leniency program expedites mergers. They also find that the EC's settlement procedure discourages and delays mergers, which they attribute to the programme's effect of reducing the penalty for cartel discovery, since this increases the relative attractiveness of cartelisation to mergers. In summing up, they state that "merger policies in the EU, the US, and many other jurisdictions may not adequately take into account the collusive history of merging firms. Because ex-conspirators often try to restore the status quo by merging or by taking other steps that lessen competitive pressures and raise prices, vigilance should not end with a cartel's punishment."

How does effective merger deterrence influence cartelisation rates?

- 6.13 We have identified fewer papers which discuss the same question in reverse. This is likely in part due to the inherent difficulties in measuring the rate of illegal activity. However, two papers in particular have engaged with the findings, suggesting somewhat contradictory results. It is difficult to conclude on the exact relationship between these two competition enforcement tools, and it may be an area for future research.
- 6.14 Cosnita-Langlais & Tropeano (2014)⁸⁶ consider whether loose merger control influences cartelisation rates by considering the example of 2010 European Commission decision fining 11 air cargo carriers for collusion. They argue that this collusion had been facilitated significantly by mergers in previous years, all of which had been cleared by the Commission. This suggests the opposite conclusion, namely that less interventionist merger review has led to cartels.
- 6.15 By contrast, Ganslandt, Persson & Vasconcelos (2011, 2012) suggest that in some circumstances, merger control can increase rather than reduce the likelihood of cartelisation. Their model starts from the premise that there are indivisible costs to creating and stabilising a cartel, not least because the

⁸⁶ Cosnita-Langlais & Tropeano (2014), p.2-3.

cartel leader tends to receive a higher fine.⁸⁷ On that basis, they show that markets with firms which are too homogeneously sized can make cartels harder to sustain. If all cartel participants are of the same size, there is no one to bear the indivisible cartelisation costs. It follows that by blocking mergers that would lead to highly homogeneous markets – for fear of coordinated effects post-merger – the competition authority may in fact be making cartelisation more likely. It is important to note that the paper is consistent with Cosnita-Langlais & Tropeano in arguing that *effective* merger review reduces cartelisation rates – however cautions that sometimes effective merger control may be more rather than less permissive.

How do cartel and merger enforcement interact with abuse of dominance legislation?

- 6.16 Although we know of no empirical research in this area, it is likely that there is a relationship between merger review and the enforcement of art. 102 TFEU/Chapter II CA98 as well. A stricter merger review regime leads to fewer dominant positions and therefore less scope for abuse.
- 6.17 The same could be true the other way around: if the law on art. 102 TFEU and Chapter II CA98 strictly constrained undertakings' ability to earn supra-competitive profits, there could be less need for stringent merger review. This is because in an ideal world anticompetitive behaviours by merged firms would be captured by competition enforcement. However, in the context of the difficulties of detecting and remedying anticompetitive behaviours, this 'substitution effect' is unlikely to be strong in practice.

⁸⁷ Cf. par. 28 of the European Commission's Guidelines on the method of setting fines imposed pursuant to Article 23(2)(a) of Regulation No 1/2003 and par. 2.14 of the OFT's – now CMA's – guidance as to the appropriate amount of a penalty.

7. Gaps and future research directions

- 7.1 Over the course of compiling this literature review, we have identified a number of areas which have not received as much attention as we think their interest importance. These areas can broadly be grouped into those concerned with methodological issues and those with particular questions about the deterrent effect.

Methodological issues

Awareness and rationality

- 7.2 Deterrence logically requires that businesses are at least aware of the relevant legislation and of the competition authority's enforcement actions. This is recognised in work done on deterrence in other areas of law enforcement. However, we note that the literature on the deterrence impact of competition law enforcement does not tend to recognise strength of awareness as a distinct factor in deterrence, usually because the authors – implicitly or explicitly – apply a version of the Becker (1968) model, which assumes that the decision to break the law is made rationally, based on a full assessment of the facts. While this might be a reasonable assumption in some circumstances, for example when analysing highly sophisticated actors with excellent legal representation, it may not always be true.
- 7.3 Previous survey work by the OFT has highlighted that awareness can play an important role in deterring anticompetitive behaviours. For example, London Economics (2011) concluded that “high profile OFT enforcement cases result in greater behavioural change than lesser known cases.” We are not aware of much other work in the literature on this point however, and this may be an interesting area for further exploration.

Unobserved cartel/merger characteristics

- 7.4 One point gaining prominence in the literature is that unobserved cartels (which may either be undetected or deterred) may have different characteristics to those which are detected by authorities and which form the basis for most empirical analysis. This is somewhat likely to be the case on the assumption that there is a reason why authorities do not detect particular cartels (eg they are smaller, or they are more stable), and that certain cartels are shelved (eg their potential overcharge is not great enough to be worth the risk of detection / too great to risk being fined that amount of money if detected).

- 7.5 Although likely to be less of an issue, there is a read across to mergers (particularly where a voluntary system is concerned). This is because not all mergers may be reviewed in detail by a competition authority with limited resources and so anticompetitive agreements may get through without much scrutiny. Further, if a composition effect exists, then deterred mergers by definition have different characteristics (chiefly higher overcharge) than observed anticompetitive mergers.
- 7.6 The literature has so far addressed these by constructing models involving assumptions about the distributions of relevant parameters; see Davies, Mariuzzo & Ormosi (2017) and Katsoulacos, Motchenkova and Ulph (2016). These produce interesting results, and suggest overall that deterrent effects are significant. Further work could be done to try to verify some of the assumptions made, and to test the sensitivity of the approach to different measures.

Aspects of deterrence

Sector specific deterrence

- 7.7 Of the papers that we have surveyed, most suggest that deterrence is greatest in the sector where the intervention took place. This is unsurprising if we think that intervention increases awareness or reveals a higher detection probability for firms in that sector (perhaps because the authority undertakes follow-up monitoring or has a sector-specific source of relevant information).
- 7.8 However, the results are not unanimous: Crandall & Winston (2003) for example do not find any evidence of merger deterrence when considering price-cost margins through time in a number of industries (although the study was subject to a number of methodological challenges). Further, so far much work in this area depends on surveys which may be somewhat subjective, or on data from the US where read across to UK and European Merger Control will always be somewhat limited.
- 7.9 To our knowledge, no significant body of work has so far considered whether sector characteristics other than previous enforcement may cause particular industries to be influenced more by enforcement than others. We might hypothesise, for example, that deterrence is more effective where awareness is higher or possibly where upstream suppliers or buyers are more engaged in the market. Further work could throw light on these issues.

Marginal impacts of and interdependencies between enforcement aspects

- 7.10 There are many studies which consider specific aspects of deterrence (such as the number of cartels or the overcharge), rather than attempting to estimate all avoided harm. However, clearly there are many interdependencies between different aspects of deterrence, and an increase in one may occur simultaneously with a decrease in another. Studies focussed on only one aspect (rather than total harm) may not therefore be showing the full picture
- 7.11 Likewise, individual aspects of enforcement are often considered independently. While this is helpful in some respects – it is useful to understand the impact of each aspect of regimes – more could be done to understand the trade-offs between different measures. For example, does increasing the enforcement rate improve deterrence at the same rate when penalties are high and when they are low?
- 7.12 Finally, while the overall magnitude of deterrence has been covered in some depth, a greater focus on how marginal changes to the competition regime affects deterrence would be welcome. It would be interesting to understand more how increases to authorities' budgets or how taking additional cases affects the overall deterrence rate.

Abuse of dominance

- 7.13 Studying the deterrent effect of abuse of dominance cases is not easy. As Crandall & Winston (2003) put it: "Monopolization cases are impossible to analyse *en masse*, because they involve different market conditions and alleged misconduct over time."⁸⁸
- 7.14 There has so far been very little work addressing how far the abuse of dominance regime leads to deterrence. One of the few attempts to do this was in Deloitte (2007) and London Economics (2011) which estimated deterrence ratios of between 4 to 1 (in the Deloitte 2007 Legal Survey) and 12 to 1 (in the London Economics 2011 survey). These ratios were notably lower than the corresponding ratios for cartels and commercial agreements. Gordon and Squires (2008) argue (for the 2007 results) that this fact may be attributable to either the current lack of guidelines for Chapter II of CA98 or

⁸⁸ Crandall & Winston (2003), p. 6. Cf. also Baker (2003), p. 33-35. The same is true, of course, for Market Investigations as they are carried out by the CMA.

Article 82, or the fact that the OFT has taken relatively few Chapter II infringement decisions.”⁸⁹

- 7.15 The relatively low volume of infringement decisions and the high heterogeneity of markets and theories of harm which characterise abuse of dominance makes this an inherently difficult area to study. However, as a key tool of competition policy and one where results are somewhat sparse, any further work here is a clear area of interest.

⁸⁹ Gordon & Squires (2008), p. 430.

8. Appendix 1: Methodologies

- 8.1 As a complement to the more detailed review of the results above, we devote a short section to discussing key methodological issues. This is because the methodologies employed in existing studies could be used in future work concerning the evaluation of the CMA's or other competition authorities' activities and understanding the relative merits of different approaches is an important consideration for any such work.
- 8.2 In the remainder of this appendix we set out seven common approaches to measuring deterrence. Having done this, we then also set out some common approaches to measuring enforcement intensity. Finally, we dedicate a section to the specific methodological challenges discussed in the cartel deterrence literature.

Measuring Deterrence

- 8.3 While the concept of deterrence is relatively clear in theory, in practice, as discussed in Section 3 of the report, significant challenges arise in its measurement. Below we set out some ways in which studies have attempted to measure deterrence.

Surveys

- 8.4 Deterrence may be measured by surveying respondents. Typically, the approach is to ask how many mergers or agreements were abandoned or modified (either with or without legal advice) before going ahead as a result of competition law. While these approaches require careful survey design and rely on being able to attain an unbiased sample size, in principle the results can be very useful, both to understand the number of behaviours that are deterred and the nature of those deterred actions.

Statistical inferences

- 8.5 Many studies attempt to get a sense of the deterrent effect by measuring statistics related to the number or characteristics of observed activities (eg caught cartels). An example is Zhou (2013), who measures the number of cartels caught in the short and long run following the introduction of a leniency scheme. Others take different but related approaches by measuring the length of cartels caught, or recapture rates. As discussed in Section 3, one of the main challenges associated with this methodology is taking into account that the observed behaviours are a non-random sample of the population of

interest, and therefore one should be cautious when making inferences between observed and unobserved behaviours.

Measuring compliance

- 8.6 Compliance may be used as a proxy for deterrence. Higher compliance efforts following a change in competition law may be an important mechanism by which firms ensure they are not engaging in cartel behaviour or proposing anticompetitive mergers.⁹⁰ Measuring these efforts may give an indication as to how severely anticompetitive activities are deterred by possible enforcement action. Compliance is often measured by a survey: see eg Hüschelrath, Leheyda & Beschorner (2011) who test a change in the Swiss regime's effect on businesses is one example. Collection of spend and/or employment data might be other approaches.
- 8.7 In theory, compliance efforts may also reduce the incidence of abuses of firms' market power, where they are in a dominant position – although in line with the small literature covering this aspect of enforcement, there is little in the literature to support or reject this hypothesis.

Laboratory experiments

- 8.8 It is sometimes possible to use lab experiments to test how industry players are influenced by regime changes. These have been common particularly in the cartel literature considering the impact of leniency schemes on deterrence – see Apesteguia, Dufwenberg & Selten (2003, 2007) and Bigoni et al. (2014, 2015) as just two examples, both discussed in the section on cartel deterrence below. While these experiments can be helpful in understanding the incentives of market players, their applicability to real life situations strongly depends on the design of the experiment and is often limited.

Theoretical models

- 8.9 Some papers take an entirely theoretical approach by developing models to predict how particular actors would respond to incentives which may be hard to measure, or to understand how unobservable aspects of competition regimes may work. These models may then be validated using data, or may draw on empirical parameters estimated elsewhere. An important example for cartels is Davies, Mariuzzo & Ormosi (2017), who model unobserved and

⁹⁰ Cf., for example, Rodger (2005). Lipson (1982) includes some interesting comments about the work of in-house counsel trying to improve compliance.

deterred cartel harm using a theoretical model using EC cartel harm estimates as an input.

Measuring price-cost margins

8.10 Some studies use price-cost margins (although some studies only look at prices) as a measure of whether anticompetitive action is prevented by an authority.⁹¹ The basic idea is that, with a sufficiently careful identification strategy, lower profitability on the part of firms could be attributed to a more competitive market achieved through intervention. Whilst commonly used in merger cases, for example as a part of pricing pressure tests, this indicator is less commonly used as an indicator of competition itself. Indeed, whilst there are some clear intuitive reasons for measuring the impact of competition authorities' activities on price-cost margins, there are also a number of potential weaknesses. We have identified three main sources of criticism, although others are also possible.

- (a) First, the validity of using price-cost margins depends on finding a good proxy for marginal costs.⁹² In practice, limited data availability and complexities in how aspects such as common costs are attributed limit the ability of both authorities and academics to develop robust measures of this variable.
- (b) Second, even where it is possible to identify reasonable measures of marginal costs in an accounting sense, observed margins are subject to a number of other confounders which limit how applicable they are as indicators of the level of competitive constraints on firms. For example, Domowitz, Hubbard & Petersen (1986) show that business cycle and sector-specific demand effects have a material impact on observed price-cost margins, and that the cyclicity of margins is higher in industries that are more concentrated.

⁹¹ As an example, in their critique of competition law enforcement, Crandall & Winston (2003) did a simple regression using price-cost margins as a dependent variable and various metrics of merger review intensity as independent variables, finding that industries with more blocked mergers did not have lower margins. Their approach has been criticized by Baker (2003), Kwoka (2003), Werden (2003), and Connor (2004).

⁹² Liebowitz (1982) studied the correlation between a variety of different proxies for the Lerner index of market power, all relying on accounting data, and found that "the price-cost margin does not measure the variable it was purported to measure, nor is it much of a proxy for more traditional profit measures." A particular difficulty pointed out by this paper was the treatment of advertising or R&D costs. As Sutton (1991) has shown, in industries where endogenous sunk costs, such as advertising and R&D costs are important, an escalation in such expenditures can result in the industry becoming strategically concentrated.

(c) Third, strategic behaviour on the part of firms may confound studies using price-cost margins, particularly where cartels are concerned. Harrington (2004) argues that it is not appropriate to estimate the impact of a cartel by comparing prices or margins before and after enforcement action, because cartel participants have an incentive to behave strategically and maintain higher prices after the competition law enforcement action. Specifically, they might do this to limit their likely civil liability. This would suggest that estimates of the impact of enforcement action on prices would yield a directionally correct result, but would tend to understate the long-term impact on the market. This is particularly true in jurisdictions such as the US where follow-on damages actions are a real concern for cartel participants.⁹³

8.11 Careful design of studies could mitigate these issues. On the first criticism, some industries are characterised by high data availability which might permit the development of a reasonable measure of marginal costs, at least where the firms and products involved are sufficiently simple (reducing cost allocation challenges). On the second, it would in principle be possible to control for such confounders in an econometric study, and careful design may mitigate these issues. The third criticism makes plain the need for researchers to consider carefully the issue of strategic responses and interpret results in a sufficiently nuanced way, but does not fundamentally undermine the usefulness of the measure.

8.12 In summary, we believe that studies using price cost margins are a useful addition to the deterrence literature, where it is clear that the authors have acknowledged the inherent limitations of the approach, designed the study to address issues which can be mitigated, and interpreted the results carefully. Ideally, other methodologies would also be available to test the results.

Stock market event studies

8.13 A number of papers have used stock market event studies. A stock market event study is an economic technique that attempts to estimate the typical stock market response to a particular type of event. This is most commonly done by estimating the average abnormal return – the difference between the return on the company's shares and the return expected given market return –

⁹³ Cf. also Froeb, Koyak & Werden (1993).

for a window of time around the announcement of the event.⁹⁴ Often, although not always, the study is conducted using econometric models.

8.14 The idea is not dissimilar from margins studies: in essence, the methodology tests whether enforcement action has a negative effect on firms' profits, which may be attributed to stock market expectations about the surplus lost from operating in a more competitive market relative to a market with an anticompetitive agreement. More specifically, assuming that financial markets are efficient⁹⁵, the event study will show positive abnormal returns for companies that are made better off by the announcement, and negative abnormal returns for companies that are made worse off. Unfortunately, the methodology has a number of weaknesses.

- (a) First, the choice of time window around the event is somewhat arbitrary: using a longer window, for example starting at 20 or 30 days before the event, accounts for any 'information leakage' that might occur before the formal announcement.⁹⁶ However, it may also introduce additional unrelated events which add noise and/or which may confound the analysis.
- (b) Second, event studies require a reliable model for calculating abnormal returns. All studies surveyed here use the Capital Asset Pricing Model (CAPM)⁹⁷ to calculate the company's expected return given the market return in the same period, but other models, such as the Fama-French three-factor model⁹⁸ or Arbitrage Pricing Theory⁹⁹ are also possible. None of them is entirely uncontroversial, and it may be appropriate to rely on

⁹⁴ It is also possible to do an event study on other types of events. An example includes the Davies, Ormosi & Graffenberger (2015) study already discussed above, which was an event study of merger activity rather than stock prices.

⁹⁵ A very well-known survey of the literature on the efficient markets hypothesis is Fama (1991). Arnold and Parker (2007) found that the efficiency of financial markets responses to merger information may depend on the stability of the regulatory regime and the experience of the industry with mergers.

⁹⁶ For merger policy Duso, Gugler & Yurtoglu (2010) suggest that a relatively long window may indeed be appropriate.

⁹⁷ CAPM is a widely used model in calculating the expected return of an asset. The basic idea is that the expected return of an asset can be decomposed between a portion which is risk free, and a portion which is risky. To make purchasing an asset worthwhile, investors must be compensated for the risky portion, and therefore the value of the stock depends on how far the asset is sensitive to market risk. There are a number of measurement challenges in estimating the relevant components of the variable, as well as a number of assumptions which need to be fulfilled for analysis based on this measure to be (fully) theoretically robust. For a discussion of the model and its shortcomings, cf. Fama & French (2004).

⁹⁸ Fama & French (1993)

⁹⁹ Ross (1976)

more than one model in order to mitigate the weaknesses of individual models.

- (c) Third, it is not always obvious how to interpret the results of an event study.¹⁰⁰ For example, when event studies are used to evaluate merger policy, scholars tend to assume either a coordinated effects theory of harm or a unilateral theory of harm permitting competitors to raise prices too. This would lead to positive abnormal returns for all companies in the sector.¹⁰¹ However, if the merger is anticompetitive because it allows the merged entity to exclude its competitors from the market, the expected abnormal return for those companies is negative, not positive. Moreover, positive abnormal returns for non-merging companies can also be explained by investors interpreting the merger announcement as a signal that there is scope for further efficiency-enhancing mergers.¹⁰²

- 8.15 In light of these limitations, the studies discussed in this report which use this methodology should be interpreted with caution. However, in principle, event studies are applicable to studies of deterrence. The idea is that where a competition authority undertakes action to prevent anti-competitive behaviour (such as breaking up a cartel or prohibiting a merger which has been identified as likely resulting in a substantial lessening of competition), this conveys relevant information to the market. Should firms be deterred by the competition authority's actions, then we would expect their future profitability to be lower (since producer surplus has been transferred to the consumer). As a result, the announcement of the intervention should see stock prices fall.
- 8.16 There are of course some substantial interpretational challenges with the application of event studies to the analysis of the deterrent effect. Most importantly, the effect of authorities' interventions can be expected to have both a direct and an indirect effect on the market. If fines are put in place, falls in the stock price may be attributable largely due to these fines rather than the fall in expected future profitability due to the firm no longer accruing rent. However, it may nevertheless be worthwhile studying the magnitude of the stock price fall to see whether the level of the fines fully accounts for the drop: if the drop is much larger and persistent, then this may be an indication that the firm has been deterred from future anticompetitive action. Other

¹⁰⁰ Cf. Motta (2004), p. 239-240.

¹⁰¹ Cf. the literature discussed in Pautler (2001), and cf. p. 10-17, Kokkoris, (2007), Duso, Neven & Röller (2007), and Duso, Gugler & Yurtoglu (2011).

¹⁰² Cf. Pautler (2001), p. 14-15 and Song & Walkling (2000). Fridolfsson & Stennek (2006) make the opposite point.

challenges are possible too, and therefore any read across from the results of event studies to the deterrent effect must be conducted very carefully.

Measuring Enforcement

- 8.17 Just as it is difficult to measure the effect on detriment (ie the dependent variable), it is not always easy to select a measure of competition enforcement (i.e. the independent variable). This is because the intensity and scope of enforcement action may vary along a number of dimensions. Further, there are challenges with measuring scope and intensity along any given dimension, and there may in practice be different ways of addressing the same question.
- 8.18 In this subsection, we categorise different approaches to measuring competition enforcement into three broad classes. In principle, each can be used with different measures of deterrence (i.e. outcomes), such as those set out in the preceding section. The classes are as follows:
- (a) those which select a particular variable and test the effect on outcomes from that variable alone;
 - (b) those which identify differences between regimes across time or jurisdictions and test whether outcomes differ across groups; and
 - (c) those which compile broad indices which seek to combine the granularity of the first with the generality of the second.
- 8.19 We provide some discussion of each of these different approaches in the following paragraphs
- 8.20 First, many studies select a particular aspect of competition law enforcement and test how far deterrence is responsive to variation in that aspect. Some make narrow claims from these studies (for example, showing the marginal impact on deterrence from an increase in that variable). Others suggest that the variable of interest may be a proxy for overall enforcement strength.
- 8.21 As a particular example of the latter, the number of enforcement actions of a given type taken by the competition authority in a given year is often used to calculate the average deterrence per enforcement. This measure has obvious intuitive benefits, in particular because greater number of investigations are likely to bring the competition authority into contact with a greater number of firms and industries. Also, this can be a good way of capturing the incremental deterrent effect of competition authorities' work as opposed to the overall deterrent effect of particular regimes. However, there are of course limitations,

most notably that more enforcement does not mean better or more thorough enforcement. Further, differences across regimes may make comparisons between countries more challenging.

- 8.22 Second, some studies abstract away from measuring inputs to deterrence at all, and use cross-group comparisons based on differences in enforcement intensity identified exogenously. As an example, Warzynski (2001) studies the impact of deterrence by dividing the period in their data (1958-1994) into two sub-periods (1958-1973) and (1974-1994) on the basis of how ‘tough’ enforcement was. He is then able to associate the regime change with a significant change in price-cost margins. While the exact division between groups may be somewhat arbitrary, the impact of choosing a slightly different definition (in this case by selecting the dividing line between periods) is not likely to have much effect on the findings if a broad enough set of data is considered.
- 8.23 Third, some studies have taken a ‘middle way’ by combining a number of measurable elements of competition enforcement regimes into an index of enforcement intensity. One notable example of this approach is in the work of Buccirosi et al. (2011) for the European Commission. In this paper, the authors develop a competition policy index (CPI) to capture the most important features of a jurisdiction’s competition policy regime.¹⁰³ This index allows them to track policy development quantitatively over time and between jurisdictions in a consistent manner. Following a similar idea, other authors have used the Global Competition Review ratings, which likewise combine a range of enforcement intensity elements into a single overall score for the authority.
- 8.24 These index based approaches have the advantage that they are not dependent on only one dimension of competition enforcement intensity (which may be uncorrelated with other key dimensions). They also permit greater variation in the independent variables than the binary approach of Warzynski set out above, which gives more power to the study and may reduce the impact of confounding concurrent policy changes, as these can be controlled for more directly.
- 8.25 However, index-based approaches also have disadvantages. In particular, there may be robustness issues arising from how the index is compiled. Studies which rely on authors’ judgements (or those of other bodies such as Global Competition Review) may be sensitive to alternative viewpoints or the

¹⁰³ Cf. Buccirosi et al. (2011, 2012, 2013).

assumptions made by authors where good data is not available. While computer-based solutions might be able to overcome these challenges - Natural Language Processing could code written statements of law and policy more consistently - considerable difficulties are likely to remain when comparing jurisdictions with significantly different legal traditions.¹⁰⁴ Further, the results of studies using indices may be hard to interpret as in many cases they abstract away from key variables of interest.

- 8.26 As a result, there is not likely to be one overall best way of measuring enforcement intensity. Papers investigating the overall magnitude of deterrence seem generally good candidates for the group-comparison or index based approaches, where specific (often substitutable) actions of the competition authorities are of lesser importance. By contrast, studies investigating the *incremental* effect of stronger enforcement along specific dimensions (e.g. fining, number of cases taken) are likely to require a narrower measurement of deterrence. The most appropriate independent variable should be decided on a case-by-case basis, depending on the particular question of interest.

Methodological challenges discussed in the literature on cartel deterrence

- 8.27 In the following paragraphs, we discuss two main challenges relating to the sample of activity that can be used to assess the characteristics of cartels, which is necessarily comprised only of cartels which are (i) not deterred and (ii) detected.
- 8.28 First, because deterred cartels by definition never occur (and are by definition never observed) estimating their number and severity is inherently difficult. It is likely that deterred cartels share different characteristics from undeterred cartels: the decision of players in one industry to favour a particular cartel over another in the same industry is probably not random. Likewise, the decision of one industry to cartelise while others do not is non-random. As a result, any conclusions drawn from the population of occurring cartels are unlikely to be valid for non-occurring (ie deterred) cartels.
- 8.29 Second, studies cannot include cartels which occur but are not observed. In practice this means that only cartels which are detected by competition authorities can be analysed. If cartels which competition authorities catch are systematically different from those which they do not catch but nevertheless

¹⁰⁴ Cf. Bradford, Chilton & O'Halloran (2015).

occur (for example, if the competition authority only catches those which are more unstable), then conclusions on deterrence may be biased, or at least may not be valid for all cartels.

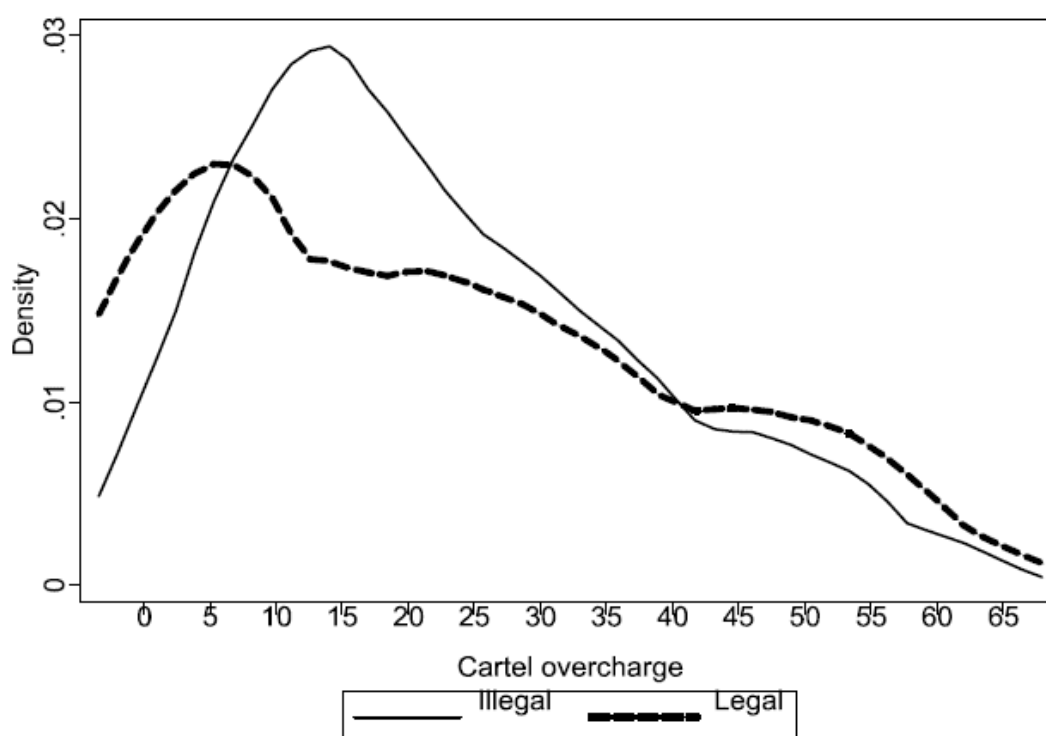
- 8.30 Both of these features are challenges when deterrence regimes are in place. However, were cartels not illegal, neither issue would arise. This is because the actions of the authorities should not influence players' decisions over whether and how to cartelise, and there is no (or less) reason to make decisions on cartel activity in secret. As a result, a sensible starting point to studying the impact of deterrence is to consider cartels in sectors, jurisdictions or time periods where cartels have been permitted.¹⁰⁵
- 8.31 There are of course limitations of using legal cartels to answer these questions. As we set out in Section 3 of the report, inference across jurisdictions may not always be valid even where they have common important characteristics (such as banning cartels). Further, since many studies of legal cartels are somewhat historical, many important factors influencing how firms behave and economies function may have changed.
- 8.32 While the most common approach, the study of legal cartels may not be the only way to address the two challenges set out in paragraphs 8.28 and 8.29. There is an emerging body of literature which takes a more theoretical approach by making plausible assumptions about cartel heterogeneity and applying these to empirical results to draw broader conclusions. However, this literature is still in its youth. We consider these two approaches in turn in what follows, beginning with studies focussing on legal cartels.
- 8.33 Fink & Frübing (2015) consider 12 key characteristics of cement cartels in four countries, Austria, Norway, Germany and Poland, alongside some reflections around how cartel laws in these countries developed. In Germany and Poland, the cartels were in operation after laws were passed making cartels illegal. In Austria and Norway, the cartels were legal during the period they were in operation.
- 8.34 They conclude that the (illegal) cartels in Germany and Poland were not structurally different from their Austrian and Norwegian counterparts. We might infer from this that illegal cartels are not fundamentally different from

¹⁰⁵ Studying legal cartels can also help to understand how much more anticompetitive action would occur without authorities' intervention. This gives something of a counterfactual to authorities' intervention and helps to understand the level of deterrence.

legal cartels. However, this conclusion would be weakened by the limited scope of this study (ie focus only on one sector).

- 8.35 Set against this, some differences between legal and illegal cartels have also been observed. Hyytinen, Steen & Toivanen (2015) notes that legal cartels studied tended to have a longer duration than previous studies of illegal cartels have suggested.
- 8.36 Further, using the Connor (2014) dataset, Bos, Davies & Ormosi (2015) produce the following distributions of overcharges for legal and illegal price-fixing cartels. The graph plots the probability density of a cartel overcharge: the probability that the overcharge is between any two points on the x-axis is equal to the area under the curve between those points.

Figure 4 Overcharge of legal and illegal cartels



Source: Bos, Davies & Ormosi (2015)

- 8.37 While the mean and the median overcharge are the same for both distributions, the tails are clearly different. Using these empirical findings together with a theoretical model of cartel formation, the authors conclude that, in response to cartel enforcement, low-overcharge cartels are abandoned, while high-overcharge cartels are moderated. As a result, deterrence appears to be particularly high impact towards the tail of the

overcharge distribution – which is more densely populated for legal than for illegal cartels (and therefore, by assumption, for the true population of cartels rather than the detected population only). This finding has two important (related) implications:

- (a) First, there is likely to be a difference between the nature of detected cartels and the nature of undetected and deterred cartels which should be taken into account when making inferences from observed infringements to deterred infringements.
- (b) Second, the findings of the paper strengthen the argument that measuring the impact of cartel enforcement by the number and severity of detected infringements (only) is likely to underestimate the welfare enhancing impact of cartel enforcement. This is because the paper has demonstrated that the differences between the characteristics of legal and illegal cartels in particular regarding overcharge are significant, and therefore even where cartels are not deterred from forming, it may well be the case that they charge less, resulting in less detriment.

- 8.38 As set out above, study of legal cartels is not the only approach to addressing questions of whether the set of observed cartels can be used to calculate the total level of overall deterrence.
- 8.39 Perhaps the most notable alternative is Davies & Ormosi (2013), in which the authors explore how the characteristics of observed harm (eg detected cartels) may be used to give information about the contemporaneous magnitude of total potential harm, including undetected harm. In order to do this, they develop a theoretical model that relates detected harm to the underlying population of all potential anti-competitive harm and calibrate this model assuming skewed distributions for certain key input variables (such as detection and deterrence rates), ie assuming that the cases that are detected are not an unbiased sample for the population of all infringements.
- 8.40 For a variety of scenarios, each consisting of different plausible values for the key parameters in their model, they find that the benefits of deterrence are considerable. However, they also find that a significant proportion of harm remains unremedied due to the non-detection of cartels.¹⁰⁶ Although the results of the analysis are sensitive to the parameters used for the calibration, the most important insight remains: applying a simple multiplier to estimate total avoided harm based on observed harm could be misleading as the observed (detected) population of infringements is not likely to be

¹⁰⁶ Note that the model assumes that competition authorities detect all anticompetitive mergers.

representative of the total population of potential anticompetitive harm. This particular study suggests that “the aggregate potential for anti-competitive harm dwarfs what is detected and recorded by a [competition authority], by a magnitude of between 10 and 30 times for cartels and 6 to 17 for mergers.”¹⁰⁷ Similar magnitudes for cartels are available in later versions of the working paper (e.g. Davies, Mazzurro & Ormosi (2017)), although the results for mergers do not appear there.

- 8.41 Overall, we note there is some heterogeneity in the literature as to how far observed cartels may be considered representative of unobserved cartels. Simply assuming representativeness is likely to cause bias in estimates of deterrence using only observed-cartel data.
- 8.42 As a result, great caution must be taken in interpreting studies which do not take this into account. In particular, we consider that the magnitudes of deterrence estimated in such studies are generally likely to underestimate the true effect. It may therefore be most appropriate to consider the results as qualitative pieces of evidence to be taken together with studies which do make some attempt to adjust for the non-randomness of the sample of cartels which is detected rather than undetected or deterred.

¹⁰⁷ Davies & Ormosi (2013), p34

9. Appendix 2: Summary tables

Table 4. Papers addressing cartel deterrence, categorised by enforcement and deterrence variable types

	Overcharge, Price Levels & Total Harm		Cartel Formation		Cartel Duration & Stability	
Regime Existence	Vickers & Ziebarth (2014)	✓	Schinkel & Tuinstra (2004)	x	Baker (1989)	✓
	Clarke & Evenett (2003)	✓✓	Deloitte (2007). London Economics (2011)	✓	Dick (1996a)	x
	Davies, Mariuzzo & Ormosi (2017)	✓✓	Van der Noll et al. (2011)	✓/x		
	Bos, Davies & Ormosi (2015)	✓				
Regime Characteristics /Severity	Warzynski (2001)	✓	Hüschelrath, Leheyda & Beschoner (2011)	✓	Harrington (2013)	✓
	Smuda (2013)	x				
Leniency	Apesteguia, Dufwenberg & Selten (2003, 2007)	✓	Apesteguia, Dufwenberg & Selten (2003, 2007)	✓	Brenner (2005, 2009)	x
	Hinloopen & Soetevent (2008)	✓	Hinloopen & Soetevent (2008)	✓	Zhou (2013)	✓✓
			Miller (2009) deterrent effect	✓✓	Zhou (2016)	✓✓
			Chang & Harrington (2008, 2012)	x	Marx et al. (2015)	x
Firm or Industry Specific Enforcement	Block, Nold & Sidak (1981)	✓	Bosch & Eckard (1991)	x	Zhou (2015)	✓✓
	Feinberg (1984)	✓	Thompson & Kaserman (2001)	x		
	Feinberg & Park (2015)	✓				
Penalties / fines	Bosch & Eckard (1991)	✓/x	Deloitte (2007)	✓	Bigoni et al. (2014, 2015)	✓/x
	Smuda (2013)	✓/x	Van der Noll (2015)	✓		
Key to symbols						
✓✓	Clear evidence of deterrence					
✓	Some evidence of deterrence					
✓/x	Mixed evidence of deterrence					
x	Evidence against effective deterrence					

Table 5. Summary of findings on merger deterrence

	Deterrence of anticompetitive Mergers		Deterrence of pro-competitive mergers	
Regime Existence	Eckbo (1992)	x	Deloitte (2007)	✓/x
	Neven, Nuttall & Seabright (1993)	✓	Van der Noll et al. (2011)	x
	NMa and TwynstraGudde (2005)	✓	Sokol (2010, 2012)	x
	Konings, Van Cayseele & Warzynski (1999, 2001)	✓/x		
	Deloitte (2007)	✓✓		
	OFT (2011b)	✓✓		
	Van der Noll et al. (2011) and Baarsma et al. (2012)	✓		
Sector specific intervention	Crandall & Winston (2003)	x		
	London Economics (2011)	✓/x		
	Deloitte (2007)	✓		
Ability to detect anticompetitive mergers	Sørgard (2009) deterrent effect	✓/x	Eckbo & Wier (1985)	x
	Duso, Gugler & Szücs (2013)	✓		
Regime Flexibility	Salop (2013)	x		
	Cosnita-Langlais & Sørgard (2014)	x		
Severity of treatment for anticompetitive mergers	Barros, Clougherty & Seldeslachts (2009, 2010)	✓	Duso, Gugler & Szücs (2013)	x
	Clougherty et al. (2014, 2015) deterrent effect	✓/x		
	Duso, Gugler & Szücs (2013)	✓		
	Lee (2015) deterrent effect	✓✓		
	Clougherty & Seldeslachts (2012)	✓/x		
Key to symbols				
✓✓	Clear evidence of deterrence			
✓	Some evidence of deterrence			
✓/x	Mixed evidence of deterrence			
x	Evidence against effective deterrence			

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