



# An Econometric Test of Bargaining Theory: Early Agreement of Remedies in EC Merger Regulation

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## *Abstract*

This paper uses the tightly specified bargaining structure required for agreeing remedies in European merger regulation to provide an econometric test of the role of uncertainty in delaying agreement. We provide a model of optimal offers by merging firms to the competition agency and the consequent probability of failure to reach early agreement (i.e. in Phase I). The model also predicts a straightforward relationship between type 1 versus type 2 errors in early agreements and the factors determining the probability of delay. We construct a database of all mergers in which remedies were agreed in either Phase I or Phase II of merger control in the last 10 years, including information on all relevant markets under appraisal. Our findings strongly support the importance of uncertainty over simple market power variables in explaining delays in agreement.

## *Acknowledgements*

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## 1. Introduction

If there is a mutually beneficial deal to be made between two agents in the presence of complete information and costs of delay, agreement should be immediate. Incomplete information can result in costly delay as agents seek to gain a greater share of the gains from agreement by either *screening* for the other party's 'type' information or *signalling* their own 'type'. There is now a vast literature on bargaining under incomplete information. Excellent reviews are provided by Kennan and Wilson (1993) and Ausubel et al (2002). Precise results depend on the structure of the game (e.g. one or two-sided uncertainty, delay between alternating offers, number of periods, nature of costs of delay), but these game theoretic bargaining models can explain at least a limited amount of delay in reaching agreement

Most of the evidence used to test such models is either experimental or relates to labour strikes during wage negotiations. Kennan and Wilson do refer to the relevance of evidence from the procedure of legal disputes as reviewed by Cooter and Rubinfeld (1989), including the descriptive statistics of agreements in competition policy cases. However, there appear to be no econometric studies that exploit the tightly specified bargaining structure that can be found in some legal structures. In particular, European merger regulation imposes a simple structure to negotiations that allows us to focus on the role of asymmetric information in screening mergers.

Merger regulation is the *ex ante* part of competition policy that aims to prevent the creation of market power by acquisition. In order to appraise the competitive effects, most jurisdictions have adopted a variant of 2-phase investigation for qualifying mergers, with a first phase deciding on whether there is a case for more detailed investigation in a second phase.<sup>1</sup> The central concern is that a merger between firms with overlapping markets may lessen the degree of competition to the detriment of customers, even though other aspects of the acquisition may create the potential for efficiencies. In order to prevent expected abuse of market power due to such a merger, a competition agency usually has the power to prohibit a merger, either administratively or by going to court. Alternatively, it can condition its approval on the merging firms undertaking either to divest some of their assets or to accept a package of behavioural restrictions. Such agreed conditions are known as 'remedies'.

Examples of remedies include the divestiture of certain products or, in the case of regional markets (or national markets within the EU), product rights in a particular geographic market. Product rights may include a brand, production facility, technology or access rights. In most jurisdictions, including the EU and USA, remedies can be agreed in either phase of investigation. Either *de jure* (as in the EU) or *de facto*, the usual practice is for the firms to make the final remedy offer to the agency, who can either accept or reject it. Rejection in Phase I results in referral to Phase II, and rejection in Phase II results in prohibition (or, as in the USA, a challenge

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<sup>1</sup> In the EU, there are explicit Phases I and II, and in the US, the equivalent of Phase II is associated with the issuing of a 'Second Request'. There is often a prior sifting of cases such that only those of a qualifying combined size (or sometimes market share) reach Phase I. Further sifting may take place if there are clearly no significant market overlaps (e.g. the EC has a 'simplified procedure' in lieu of Phase I in such cases; EC (2005)). Such mergers fall outside the context of the present paper because they do not raise issues relating to remedies.

in court). Thus, remedy negotiations do not take exactly the conventional form of sharing a cake between the two parties. Instead, the proposer of the merger must offer the competition agency sufficient of the merging firms' assets to eliminate the agency's expectation of competitive harm. In mature competition regimes like the EU or USA, remedy agreements (i.e. conditional approval) are an order of magnitude more common as a means of eliminating competitive concerns than are outright prohibitions. This leads us to focus on the speed of agreement over remedies as opposed to failure to agree at all.

The central question addressed in this paper is: why are some remedy agreements made early (i.e. in Phase I) while others are delayed (i.e. until Phase II)? Two institutional features make the EU merger control regime attractive for understanding this. First, it has relatively strict statutory time limits on investigations in each phase. Second, it is essentially an administrative system, subject to judicial review, giving the agency considerable discretion in coming to a decision provided that it can base that decision on consistent evidence.<sup>2</sup> In addition, the publication of relatively standardised reports for each merger means that a consistent database can be created for a large number of mergers.

Based on these institutional features, section 2 provides a simplified version of a model of remedy agreement proposed by Lyons and Medvedev (2007).<sup>3</sup> Section 3 provides some background on trends in remedy agreements under the ECMR. Section 4 discusses our merger database and section 5 presents estimates of the econometric model of delayed agreement. Section 6 concludes.

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<sup>2</sup> See Vesterdorf (2005) for evidentiary requirements as set out by a leading judge, and Scott (2007) and Zhu (2006) for summary comparisons of the US and EU systems of merger control.

<sup>3</sup> There have been few previous attempts to model bargaining over remedies in merger regulation. Farrell (2003) applies Nash bargaining to determine the appropriate welfare standard of a competition agency which values efficiencies due to a merger.

## 2. A Model of Bargaining over Merger Remedies

The fundamental problem for the agency is that, at least initially, it has less information than the merging firms do with respect to the conditions of competition in the market. Even if it has sufficient evidence to deduce that a significant lessening of competition would result from the initial merger proposal, it may be difficult to design appropriate remedies; i.e. remedies that adequately address the competition concern without unnecessarily restricting the freedom of firms to seek efficiencies and profitable opportunities. The purpose of an investigation is to discover relevant information, but such inquiries are costly to both parties. The merging parties do not have a general incentive to reveal the truth because they would prefer to keep as many assets as possible, especially those that would enhance market power. Nevertheless, the agency does have the power of veto as long as it can provide evidence to support its judgement.

The essential structure of our model is as follows. The agency would like to find the 'true remedy' that would resolve competition concerns with minimum intervention. As a first approximation, the firm knows this while the agency does not, so it conducts a Phase I investigation to obtain an independent estimate of the true remedy. One determinant of the accuracy of the agency's estimate is the amount of resources that it invests in the investigation (e.g. time, number of people, use of experts). The first phase of investigation is not perfect, so the agency can make a mistake.<sup>4</sup> Appreciating this, it compares the results of its own investigation with the proposed remedy that is offered by the merging firms. If the offer is supported by the results obtained from its own investigation, then the agency approves the merger subject to the proposed remedy. Otherwise, it proceeds into the second phase. In Phase II, the agency conducts a more detailed investigation with more resources (e.g. four months in the EU) and consequently greater accuracy. Such a detailed investigation is costly for both the merging firms and the agency.

### *Assumptions*

We suppose that the assets of the acquired firm can be represented by a unit line. Assets are arranged by competitive impact such that those with least competitive impact are located at zero, and those with most harmful competitive impact are located at one. We assume that there is a partition of assets such that those located at  $\alpha < \alpha^T$  have no significantly adverse effect on competition, while  $\alpha > \alpha^T$  would significantly impede competition if joined with the acquiring firm's assets.  $\alpha^T \in (0,1)$  characterises the 'true' remedy in that if all assets labelled  $\alpha > \alpha^T$  were divested, the merging parties could retain the maximum possible assets that would leave the degree of effective competition unchanged. For example, assets located at  $\alpha < \alpha^T$  may be in non-competing markets, or the merger may lower costs such that customer price and service would be unchanged (or improved) despite the merged firm's larger market share. If the outcome is  $\alpha = 1$ , the merger proceeds without remedy, and if  $\alpha = 0$ , the merger is completely prohibited or abandoned. Any agreed  $\alpha \in (0,1)$  represents a potential remedy.

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<sup>4</sup> In the EU, the agency has just one month to appraise the merger in Phase I.

$\alpha^T$  is known by the firms but not by the agency. As a result of its Phase I investigation, the agency obtains its own estimate of the required remedy  $x_1$ . This signal  $x_1$  is assumed to be unbiased in the sense that it is drawn out of the distribution of  $x$  with mean  $\alpha^T$ . For simplicity, we assume the distribution to be uniform such that  $x \sim U[\alpha^T, \sigma_1^2/3]$ , so  $[\alpha^T - \sigma_1, \alpha^T + \sigma_1]$  is the range.<sup>5</sup> Both the agency and the firms know the interval of the distribution is  $2\sigma_1$ , but only the firms know the true mean. In other words, the agency knows the width of the interval out of which it draws  $x_1$  but not the position of this interval on  $[0, 1]$ . However, we do assume the agency knows that the merger is remediable, so  $0 < \alpha^R - \sigma_1$  and  $\alpha^T + \sigma_1 < 1$ .  $\sigma$  is exogenous to any particular merger. It depends on the prior allocation of resources to the agency and the inherent complexity of the competition appraisal.

The agency's decision should also be supported by evidence such that it can be justified in court. Thus, the agency is concerned that if it has evidence that  $\alpha > \alpha^T$ , enhanced market power would harm consumers (relative to pre-merger) so it should reject such a remedy offer; but if the evidence suggests that  $\alpha \leq \alpha^T$ , there is no expected harm to consumers so such a remedy should be agreed. After obtaining its own estimate of the true (ideal) remedy, the agency compares its preliminary finding,  $x_1$ , with the offer made by the firm,  $\alpha^O$ , and applies an approval rule. In this paper, we consider the following approval rule: if  $x_1 \geq \alpha^O$ , then approve the remedy, otherwise proceed to the next phase. The process would be repeated in Phase II; i.e. the firm makes an offer  $\alpha^{OO}$ , and simultaneously the agency picks up its own signal  $x_2$  out of the distribution of  $x$ , where in Phase II,  $x \sim U[\alpha^T, \sigma_2^2/3]$  and  $\sigma_2 < \sigma_1$ . If there is a second round (Phase II), then the agency and the firm bear exogenous costs  $K_A$  and  $K_F$  respectively.

Note that if the agency learns the value of the true remedy for sure in the second phase, i.e.  $\sigma_2 = 0$ , then  $x_2 = \alpha^T$ . In this case, it is clearly always optimal for the firms to offer  $\alpha^{OO} = \alpha^T$  if they get to Phase II.

We assume that the expected profit enhancement from the merger is proportional to the fraction of assets that the firms retain after remedies are approved by the antitrust agency. Profits would increase by  $\pi$  if no remedy was required (i.e. if  $\alpha = 1$ ). Clearly, the firms want the agency to agree as high an  $\alpha$  as possible. The objective of the merging firms is to choose a remedy offer so as to maximize expected profit (as compared with the pre-merger situation).  $\alpha^O \in [0,1]$  is the remedy offered by the merging firms in Phase I, and  $\alpha^{OO} \in [0,1]$  is offered in Phase II (if reached). The merging firms are risk neutral so their objective is:

$$\begin{aligned} \text{Max}_{\alpha^O, \alpha^{OO}} \{ & \Pr(\text{Approval in Phase I}) \alpha^O \pi + \\ & + [1 - \Pr(\text{Approval in Phase I})] * [\Pr(\text{Approval in Phase II}) \alpha^{OO} \pi - K_F] \} \quad (1) \end{aligned}$$

Note that the probabilities of approval will depend on the remedy offers.

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<sup>5</sup> We assume a uniform distribution only for simplicity, and similar results are obtained if we use a triangle or any other distribution with a finite support within  $(0, 1)$ .

$$\Pr(\text{Approval in Phase I}) = \Pr(\alpha^o \leq x) = 1 - \Pr(x < \alpha^o) = \Pr(\alpha^o) = \frac{1}{2} \left[ 1 - \frac{\alpha^o - \alpha^T}{\sigma_1} \right]$$

There are four qualitatively different types of error in remedy selection. There may be: Type 1 errors associated with the agency accepting an excessive remedy that prevents some profitable opportunities that would not harm consumers; Type 1D ‘drastic’ errors arising if the merger is prohibited or abandoned, despite there being desirable features that could be remedied; Type 2 errors associated with allowing mergers that are harmful to consumers; and what we call Type 3 errors associated with incurring Phase II investigation and compliance costs when these could have been avoided by reaching agreement in Phase I. We describe Type 1 and Type 2 errors as ‘incremental’ in the sense that they arise from a choice of remedy that is somewhat too strong ( $0 < \alpha < \alpha^T$ ) or somewhat too limited ( $0 < \alpha^T < \alpha$ ), but which do not result in the discrete events of no merger or a Phase II investigation. The welfare cost of these errors can be measured relative to the ideal remedy of  $\alpha = \alpha^T$ .

### *Optimal Phase I offers and consequent probabilities of delayed agreement*

Because of the possibility of a corner solution (where the firms offer a sufficiently ‘generous’ remedy to ensure acceptance), or internal solution, or Phase II prohibition, there are three regions to consider.

$$1) \quad 0 \leq \sigma_2 < \sigma_1 \leq \frac{\alpha^T}{3}$$

When there is a relatively small proportion of the merger in dispute (i.e.  $\alpha^T$  is close to 1), the optimal offer is sufficiently generous such that even if the agency’s evidence is the worst that the firm can expect, the offer will still be accepted. The optimal offer is  $\alpha^* = \alpha^T - \sigma_1 < \alpha^T$ , so is always excessive (i.e. Type I error). The probability of failure to agree in Phase I is consequently zero:  $1 - \Pr(\alpha^*) = 0$

$$2) \quad 0 \leq \sigma_2 \leq \frac{\alpha^T}{3} \leq \sigma_1$$

In this case, there is more of the merger in dispute relative to the agency’s accuracy of Phase I evidence. However, the Phase II investigation is expected to be sufficiently accurate such that even if the agency’s evidence is the worst that the firm can expect, the firms’ Phase II offer will still be accepted. The optimal offer in Phase I is  $\alpha^* = \alpha^T + \frac{1}{2}[\sigma_1 - \sigma_2 - K_F/\pi]$  and if Phase II is reached the offer would be  $\alpha^{**} = \alpha^T - \sigma_2 < \alpha^T$ .

If  $\sigma_1 > \frac{K_F}{\pi} + \sigma_2$ , the Phase I offer is deficient (i.e. Type 2 error of  $\alpha^* > \alpha^T$  if accepted). Otherwise, the offer is excessive (i.e. Type 1 error). Put another way, the absence of either Type 1 or Type 2 errors is on a knife edge requiring  $\frac{\sigma_2}{\sigma_1} = \frac{K_F}{\pi\sigma_1}$ .

The probability of failure to agree in Phase I is  $1 - \Pr(\alpha^*) = \frac{1}{4} \left[ 3 - \frac{\sigma_2}{\sigma_1} - \frac{K_F}{\pi\sigma_1} \right]$ , but

there is a zero probability of failure to agree in Phase II. This is decreasing in the accuracy of the agency's Phase I evidence and the cost to the firms of delay into Phase II. *Notice that the probability of failure to agree in Phase I is exactly  $\frac{1}{2}$  in the knife edge case of neither Type 1 nor Type 2 error in the Phase I offer.*

$$3) \quad 0 < \frac{\alpha^T}{3} \leq \sigma_2 < \sigma_1$$

When there is a large proportion of the merger in dispute relative to the accuracy of the agency's Phase II evidence, there is a possibility of a prohibition.

The optimal offer in Phase I is  $\alpha^* = \alpha^T + \frac{1}{2} \left[ \sigma_1 - \frac{K_F}{\pi} \right] + \frac{1}{2} \left[ \frac{(\alpha^T + \sigma_2)^2}{8\sigma_2} - \alpha^T \right]$

and if Phase II is reached then the optimal offer would be  $\alpha^{**} = \frac{\alpha^T + \sigma_2}{2}$ . Thus, the

Phase I offer may be either deficient or excessive and the Phase II offer is always excessive.

The probability of failure to agree in Phase I is

$1 - \Pr(\alpha^*) = \frac{1}{4} \left[ 3 - \frac{K_F}{\pi\sigma_1} + \frac{(\alpha^T + \sigma_2)^2}{8\sigma_2\sigma_1} - \frac{\alpha^T}{\sigma_1} \right]$ . This is negatively related to the firms' costs of Phase II ( $K_F / \pi$ ).

The probability of failure to agree in Phase II (i.e. prohibition of the merger) is:

$1 - \Pr(\alpha^{**}) = \frac{1}{4} \left[ 3 - \frac{\alpha^T}{\sigma_2} \right] > 0$  in the relevant range for this case.

Taking these results together, we find that failure to agree to remedies in Phase I is more likely when:

- The merger is more complex or the agency is less able to appraise evidence accurately ( $\sigma_I$  is high): e.g. a larger number of relevant markets; merger assessed by an inexperienced agency.
- Delay is more costly to the firms ( $K_F / \pi$  is high or  $\alpha^T$  is low): e.g. the proportion of the markets at issue is high (if only one small market were at issue, it is more likely to be sacrificed as a remedy so that the rest of the merger can be implemented)

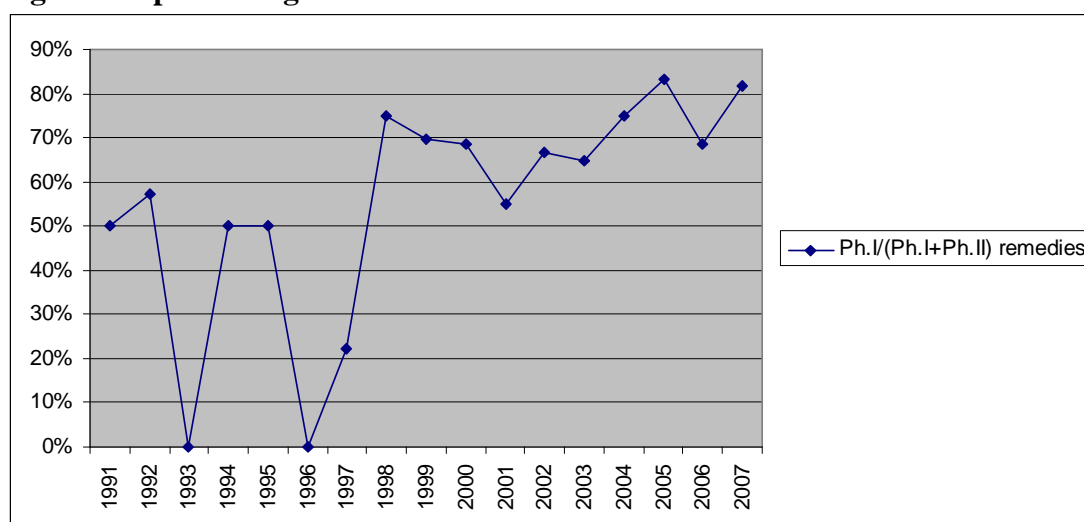
It is also interesting to note what we do *not* find to be relevant. Given the endogeneity of the firms' offer, the model does not suggest that the inherent competitive harm of a merger matters. This can be dealt with in the remedy offer. It is the accuracy of evidence that is the key to determining expected delay. For example, a merger

creating very high combined market shares should not take longer to agree a remedy than one where the combined share is more marginal to having a competitive effect. Similarly, the combined size of a merger should not matter except to the extent that size is associated with complexity.

### 3. Early Agreement of Remedies under the ECMR

The European Commission decided on 3,579 qualifying mergers between September 1990 (i.e. when the first cases were decided under the ECMR (1989)) and the end of 2007. During this time, 158 mergers were remedied in Phase I, 83 were remedied in Phase II, and just 20 were prohibited.<sup>6</sup> Measuring the speed of agreement by the percentage of all remedy agreements in each year made in Phase I, Figure 1 reveals two distinct periods. In the early years of the ECMR, there was some uncertainty as to the legality of agreements made in Phase I. This was clarified in a 1997 amendment to the ECMR.<sup>7</sup> For this reason, our empirical work focuses on the decade 1998-2007. During the last decade, 70.6% of remedied mergers were remedied in Phase I and Figure 1 reveals no clear trend over time.

**Figure 1: Speed of Agreement**



Source: DG Competition website and Lyons (2008)

<sup>6</sup> An additional 30 were withdrawn during Phase II and a substantial proportion of these may have been in anticipation of a prohibition decision.

<sup>7</sup> See revision to Art.6(1) in COUNCIL REGULATION (EC) No 1310/97 of 30 June 1997 amending Regulation (EEC) No 4064/89 on the control of concentrations between undertakings (OJ L 180, 9.7.1997, p.1-6). A change in the 2004 revisions to the ECMR may also have had some effect because it no longer requires firms to notify one week after the conclusion of the deal. However, the earlier rule was not often respected and the suspension provides sufficient incentives to ensure that firms normally notify without excessive delays. I am grateful for Carles Esteva-Mosso's opinion that this change has not had a significant impact in remedy negotiation. First, it is uncommon that companies are ready to start negotiating remedies in pre-notification. Second, even before the 2004 modification, the Commission was happy to discuss remedies in pre-notification (e.g. Unilever/Bestfoods). As ever, they engage in discussions without prejudice of the results of Phase I investigation. If new concerns arise during the investigation or during 'market testing', parties could be required to improve the remedies.



In this last decade, 6.9% of all merger proposals qualifying for investigation were agreed subject to remedies. This compares with just 0.4% being prohibited (and a further 1% withdrawn during Phase II). Figure 1 does not reveal the significant impact of three important reverses the Commission felt in the appeal courts in 2002 and a set of internal reform introduce 2002-04.<sup>8</sup> Since 2002, there have been just two prohibitions (i.e. 0.1% prohibition rate). The share of prohibitions in total interventions (i.e. prohibitions plus remedy agreements) has fallen from 9.3% in 1998-2001 to 1.8% in 2002-07. This has been accompanied by a fall in the average referral rate (i.e. to Phase II) from 5.6% to 4.4%. In this context, the speed of agreement has remained remarkably stable. [but we shall need to check for trend effects in the econometrics]

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<sup>8</sup> See Lyons (2008) for more detail.

## 4. Merger Database

### *The Commission's 'checklist'*

For each market that is considered, the EC state whether they expect the merger to cause a competition concern, or not. In a small number of cases, the EC leave open whether the market causes concern or not. We assume that these markets cause concern because they nearly always are remedied. Where there is a difference between the parties' data and that found by the EC's market investigation we use the EC's estimated data, as firms may have an incentive to bias the data.

In general, the EC uses at least four pieces of information to assess whether a market that is affected by the merger on a horizontal level causes competition concerns: (i) the merged entity's market share; (ii) the added increment of the merger on the largest firm of the merging entity's market share; (iii) its (largest) rival's market share; and (iv) whether barriers to entry exist.

Business confidentiality limits the amount of information published in a decision document, and market shares are usually given as a range (e.g. [30-40]%). In such circumstances we take the mid-point to estimate the value of the market share. When the merged entity's market share is not provided we estimate it by summing the merging parties' individual market shares (again, using the mid-point if they are stated in ranges). For each horizontal market, the merged entity's market share is almost always provided either directly or indirectly from the merging parties' individual market shares.

Market share data is less often provided when there is no competition concern. The data provided appears to be determined by a structured approach. For instance, if the merged entity's market share is 'low' the merger in that market is deemed not to concern to competition; but, if it is 'high' the size of each of the merging parties' market shares are considered. If there is only 'small' overlap of the firms' market shares, the merger in that market is deemed not to concern to competition; but if there is 'large' overlap rivals' market shares are considered, and so on. As a result, some information, namely the markets shares of the merged entity and individual merging parties, is more commonly available than others.

### *The sample*

The current dataset is constructed from European Commission (EC) merger documents between 1999 and 2006 (and is being extended to 1998-07). The sample will include all horizontal mergers that were agreed subject to remedies. More formally, the decisions were made under either Articles 6.2 (i.e. Phase I) or 8.2 (i.e. Phase II) of the ECMR, which means they were allowed subject to 'commitments'. The current dataset includes 107 EC merger decisions.<sup>9</sup>

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<sup>9</sup> This is over half of all remedies decisions 1998-07. The current sample excludes 16 mergers that have at least some markets that cause concern of coordinated effects, 2 Spanish and 11 French documents. This data is in the process of being collected. A further 7 mergers are excluded because of lack of data. This occurs when there are no horizontal markets, in which case the required data is either censored from the document or is not presented as it does not provide an adequate approximation of market power.

All but eight of the mergers included in the dataset are multi-market. This adds to the complexity of a merger investigation and is an important dimension to the costs and benefits of a merger. Multi-market activity has two dimensions. Apart from multi-product firms, European merger control often identifies multiple geographic markets (e.g. national markets in several Member States).<sup>10</sup> Consequently, some relevant data is merger specific (e.g. number of relevant markets) and other data is market-specific (e.g. market shares). For the purpose of this paper, we have aggregated the market-specific data to construct an index for each merger.

### *Merger variables*

Number of relevant markets: this is our main measure of *merger complexity* (i.e.  $\sigma_I$ ). However, a simple count of markets would be insufficient for our needs. This is for two reasons. First, complexity is not created by markets that can be trivially dismissed as not relevant to a competition assessment. It is only those that require resources to investigate that should be significant. Second, there may be a reporting bias between Phase I and Phase II decision documents. The consequent measurement issues are discussed in detail below.

Merger sequence number: each merger notification is given a number (e.g. M.2500). Not all of these reach decision stage, but we include this number as a proxy for the EC's experience – as this sequence number increases, the EC has analysed more prior mergers and this experience should allow it to collect and process evidence more efficiently (i.e. reduce  $\sigma_I$ ).

Domicile of merging parties: EEA only; EEA and US; US only; or other. This is used in the form of a set of dummy variables in order to test for any pro-European bias that is sometimes claimed by commentators.

Proportion of merger raising concern (markets raising concern as % of all markets): Commission decisions identify individual markets that raise a prima facie cause for concern. These markets are then subjected to particular scrutiny. If this is just a small proportion of all markets covered by the merger, the relative cost of delay for the merging firms will be higher than if a large number of markets are at issue. For example, if there is just one out of fifty markets at issue, the merging firms will lose out on failing to integrate in the 49 unproblematic markets for the duration of the investigation; whereas if 49 out of 50 raise concern, the cost of a Phase II investigation will be small relative to the profit sacrifice necessary for an acceptable Phase I remedy.<sup>11</sup> This is our main measure of  $K_F/\pi$ .

[We are currently collecting data on combined revenue of the merged parties. This is very incomplete and rarely provided in decision documents (currently available for only 69 mergers). We do not expect it to be a significant determinant of delay as it does not reflect the main variables in our model, but it will be included as a 'negative

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<sup>10</sup> Previous studies collecting similar merger data (see below) have concentrated on a single market to represent the market.

<sup>11</sup> This holds under the assumption that all markets are the same size. Data on the size of markets is usually censored in the public documents.

test’ of the theory with a naïve justification along the lines ‘big mergers take longer to decide’.]

[We are also collecting evidence on whether barriers to entry were high or low. However, we are concerned with a possible reporting bias with a greater likelihood of given barriers being reported in a Phase II decision than in Phase I decisions, because the analysis in phase II documents is more thorough.]

Market shares. For each market that is horizontally affected by the merger we collected: the individual market shares of each of the merging parties; the combined market share of the merged entity;<sup>12</sup> and the market share of the merged entity’s largest rival. These market shares are the key screens used by the Commission in its merger analysis. A naïve story of speed of agreement might be that more harmful mergers (e.g. those, *ceteris paribus*, with higher market shares) are referred to Phase II while less harmful ones are agreed in Phase I. This story ignores the crucial incentive effects developed in our model. However, it provides a potentially powerful ‘negative test’ of our theory. Our index of combined market shares is the average combined market share across markets raising ‘concerns’.

#### *Number of horizontal markets in a merger*

Phase II decision documents follow a longer investigation and, not surprisingly, tend to be much longer than Phase I decisions. It is important for our methodology that this should not introduce a bias in our measurement of the quantitative aspects of mergers.<sup>13</sup>

Our first filter is to exclude all markets with no horizontal overlap. This eliminates vertical mergers and a very small number of markets that cause concern because the merger eliminates a potential entrant. Our purpose is to focus as much as possible on horizontal mergers.

Our second filter is necessary to eliminate a reporting bias between Phase I and Phase II reports. The number of markets that are affected by horizontal overlap is complicated, because there is a significant difference in the data provided by phase I and phase II documents for markets where there is no competition concerns. Phase II decision documents tend to summarise a number of markets that do not cause concern with only cursory analysis (presumably so they can focus more resources on the markets that cause concern) whereas phase I documents tend to provide data for markets regardless of whether there is likely to be concern or not. Therefore, the number of markets discussed in phase I documents is biased upwards relative to phase II documents.

To eliminate the bias of over (under) reporting of markets that are of no concern to competition in phase I (phase II), we only include markets where the merged entity will hold a combined market share over a certain threshold. In effect, when the threshold is set at a sufficient level, the data is restricted to markets in which the EC has to perform non-trivial analysis to assess whether a merger causes a concern for competition in a market. Figure 2 shows the number of markets (with and without

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<sup>12</sup> This is used by the Commission to proxy for expected post-merger market shares.

<sup>13</sup> Phase I reports are not published if a merger is referred to Phase II. Thus, each merger generates either a Phase I or a Phase II report but not both.

competition concerns) that are removed from the dataset at each market share threshold. Unsurprisingly, the vast majority of markets that are eliminated from the dataset for a market share threshold below 40% are without competition concerns.

**Figure 2** – Number of Markets Removed by a Market Share Threshold with and without Concern

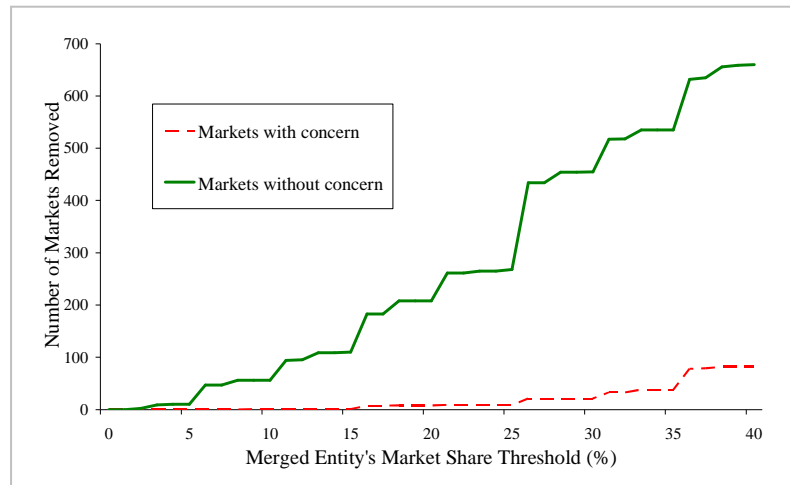
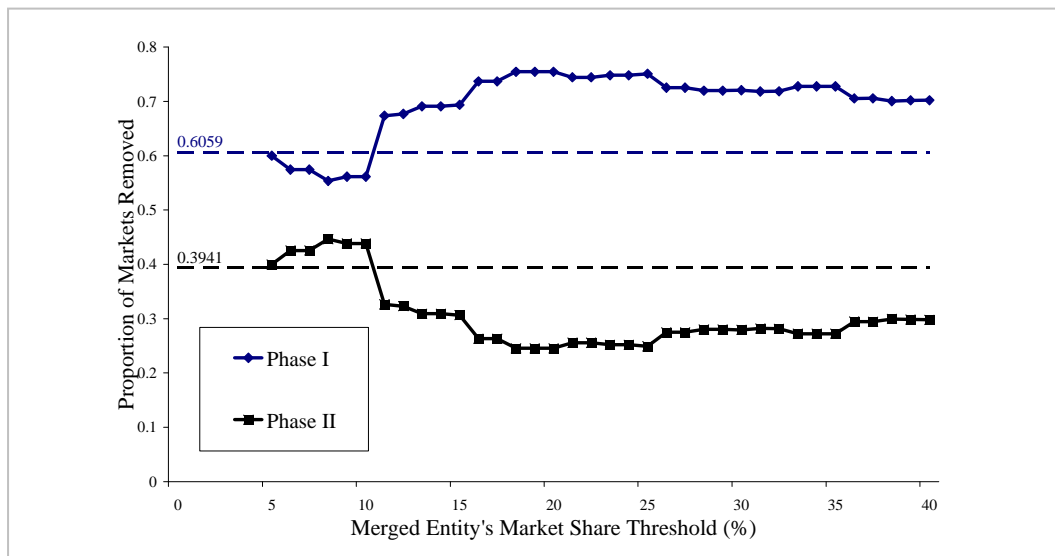


Figure 3 shows the proportion of markets from phase I and phase II documents that are removed from the dataset as a result of the market share filter. The number of markets included in the dataset without introducing a market share threshold is 1728, of which 1047 markets are given from mergers agreed in phase I and 681 from mergers agreed in phase 2. If there was no significant difference between the markets removed from phase I and phase 2 markets, one would expect a proportion of  $(1047/1728 =) 0.6059$  to be removed from mergers agreed in phase I, and a proportion of  $(681/1728 =) 0.3941$  from mergers agreed in phase II. At a threshold of over 10%, Figure 2 shows that there is a higher proportion of markets in mergers agreed in phase I removed from the dataset.<sup>14</sup>

**Figure 2** – Proportion of Markets Removed by a Market Share Threshold in Phase I and Phase II



<sup>14</sup> Using a binomial test, the proportion of removed markets from phase I documents is found to be statistically significantly different at thresholds of 15%, ( $p=0.035$ ) and 20% and 25% (both  $p=0.000$ ).

Based on Figure 3, we focus mainly on the 20% threshold, because we only eliminate a small proportion of markets compared to higher thresholds, and the proportion of markets eliminated from phase I and phase II mergers becomes relatively stable at 20%. Our econometric results include a sensitivity analysis for alternative thresholds..

### *Descriptive statistics*

Table 1 provides the descriptive statistics of the dataset after applying a market share threshold of 20%. The table enables a basic comparison of mergers that are agreed in phase I with mergers agreed in phase II, as well of the difference between markets with and without concern.

Comparing markets with and without concern, the data means tell a simple, yet intuitive story. First, the merged entity has a higher market share in markets where concern is found, on average. Second, the same applies to the incremental market share.<sup>15</sup> Third, a market is less likely to create concern if the merged entity has a larger rival.

Comparing phase I and phase II averages, there is a close similarity between mean market shares of the merged entity in each phase. The similarity extends to incremental market share and the largest rival, and for markets with and without concern. Also, although we have fewer observations due to data limitations, the merging parties' combined revenue seems to be higher for phase I than phase II. However, both the number of relevant markets and the number of those markets that cause concern are larger for the mergers that are agreed in phase II.

Finally there appears to be a greater number of markets with high barriers to entry in phase II. We believe that this is due to a reporting bias between phase I and phase II documents. Analysis in phase II documents is more thorough and so high entry barriers are more likely to be stated in phase II documents relative to phase I. As a result, it is not necessarily that markets with high entry barriers are less likely to be agreed in phase I; instead, high entry barriers are less likely to be stated in phase I documents.<sup>16</sup>

These descriptive statistics tell a suggestive story, but they cannot take account of correlations between the variables. This is why we next provide a Probit analysis.

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<sup>15</sup> This reflects a standard aspect of EC merger analysis – the presence of a ‘strong rival’ (i.e. third party with a large market share) reduces the expected loss of rivalry due to a horizontal merger.

<sup>16</sup> Evidence for this interpretation is provided by the lower proportion of markets reported with either high or low barriers to entry in Phase I (see Table 1).

**Table 1** – Descriptive statistics of the dataset with 20% market share threshold

Variable	Phase 1					Phase 2				
	Number of observations	Mean	Standard Deviation	Min	Max	Number of observations	Mean	Standard Deviation	Min	Max
Merger number	75	2884.85	881.76	1381	4242	32	2548.84	790.46	1439	4000
non US	53	0.71	0.43	0	1	26	0.81	0.43	0	1
US only	5	0.07	0.25	0	1	4	0.13	0.34	0	1
EEA and US	17	0.23	0.42	0	1	2	0.06	0.25	0	1
Combined revenue (€ millions)	46	43703.44	98168.13	9.375	647300	23	29233.53	34728.63	3.99	142186.80
Number of markets	75	11.68	13.69	1	59	32	19.56	29.91	1	142
Markets with concern	75	5.11	7.72	1	38	32	11.53	21.54	1	113
% market with concern	75	0.50	0.29	0.06	1.00	32	0.68	0.31	0.04	1.00
<b>Markets with concern:</b>										
Merged entity's mean market share*	75	60.26	16.81	28.33	100.00	32	63.92	14.77	35.00	92.50
Smallest firm's mean market share*	75	18.33	10.16	2.50	50.00	32	17.92	7.72	1.00	32.76
Largest rival's mean market*	65	18.79	11.06	0.00	45.00	31	15.21	9.47	0.00	40.00
<b>Markets without concern:</b>										
Merged entity's mean market share*	63	35.94	11.04	20.00	70.00	22	37.67	9.16	22.50	58.00
Smallest firm's mean market share*	63	10.76	5.52	2.50	30.00	22	10.53	3.24	5.00	17.50
Largest rival's mean market*	50	25.18	9.03	5.00	50.00	19	27.35	12.47	10.75	60.00
Markets with high entry barriers	75	2.79	4.94	0	26	32	8.84	12.64	0	48
Markets with low entry barriers	75	0.96	2.63	0	13	32	1.34	5.64	0	32

**Note** – \* Mean market shares are averaged across markets for each merger. The mean value in the table is the average across mergers.

## 5. Econometric Estimates

Table 2 provides the results of the Probit analysis of the data set with 20% market share filter. The dependent variable =1 if agreement is in Phase II and =0 if agreed in Phase I, so the results can be interpreted as explaining the probability of delay in reaching agreement.

**Table 2** – Probit Analysis of Probability of Delayed Agreement

Dependent variable: Phase II=1	Probit Analysis			
	(1)		(2)	
	coefficient (standard error)	marginal effects	coefficient (standard error)	marginal effects
constant	-0.56384 (0.5850)		-0.4537 (0.8218)	
number of markets	0.0230** (0.0096)	0.0075	0.0233** (0.0098)	0.0076
merger number	-0.0004** (0.0002)	-0.0001	-0.0004** (0.0002)	-0.0001
% markets with concern	1.4293*** (0.4817)	0.4638	1.4411*** 0.4861	0.4676
US only†	0.04634 (0.5148)	0.0152	0.0546 0.5171	0.0180
EEA and US†	-1.2281** (0.4911)	-0.2863	-1.2451** 0.5000	-0.2889
merged entity's mean market share	-	-	-0.0018 (0.0092)	-0.0006
Number of observations	107		107	
Log likelihood	-53.4285		-53.4103	
R-squared	0.1815		0.1818	

**Note** – 20% Market Share filter applied for number of markets, \* 10% significance level, \*\* 5% significance level and \*\*\* 1% significance level. † Marginal effect is for discrete change of dummy variable from 0 to 1.

The econometric analysis confirms the theory's predictions. Complex mergers that have a large number of (non-trivial) markets are less likely to be agreed in phase I. In addition, as the Commission becomes more experienced (i.e. the merger number increases), mergers are more likely to be agreed in phase I. The proportion of the markets that have concern provides a measure of how costly it is for the merging parties if a merger is delayed until phase II (i.e. as the proportion tends to zero the merging parties will have a greater incentive to offer remedies that will be acceptable in phase II). This is significant at the 1% level: mergers with high proportion of concerned markets are less likely to be agreed in phase I.

Finally, we tested for to see if there was any evidence of 'nationalistic' bias in favour of EU mergers. In fact, we find no difference between EEA only mergers (which are



the base case along with a small number of other domiciles) and US only mergers. Furthermore, the evidence is that mergers between firms based in the EEA and US are more likely to be agreed in phase I compared to mergers with no US firm.

The second specification in Table 2 provides a ‘negative test’ of the theory, by including a measure of the merged entity’s average market share. Consistent with our theory, this has no effect on the likelihood of delayed agreement.

### *Sensitivity analysis*

**Table 3** – Sensitivity Analysis of Alternative Market Share Filters

Market Share Threshold	Probit analysis					
	0%		15%		25%	
Dependent variable: phase II	(1)	(2)	(1)	(2)	(1)	(2)
constant	-0.4242 (0.6453)	-0.5798 (0.8993)	-0.5988 (0.5783)	-0.5276 (0.8167)	-0.5395 (0.5996)	-0.4218 (0.8277)
number of markets	0.0253** (0.0108)	0.0248** (0.0109)	0.0207** (0.0090)	0.0209** (0.0092)	0.0233** (0.0098)	0.0237** (0.0100)
merger number	-0.0003* (0.0002)	-0.0003* (0.0002)	-0.0004** (0.0002)	-0.0004** (0.0002)	-0.0003** (0.0001)	-0.0004** (0.0002)
% markets with concern	0.9209* (0.4905)	0.9271* (0.4912)	1.5532*** (0.4673)	1.5610*** (0.4719)	1.2884*** (0.4776)	1.3030*** (0.4835)
US only†	0.0864 (0.4954)	0.0770 (0.4971)	0.0436 (0.5186)	0.0497 (0.5212)	0.0565 (0.5087)	0.0655 (0.5110)
EEA and US†	-1.1151** (0.4686)	-1.0945** (0.4750)	-1.1949** (0.4878)	-1.2046** (0.4946)	-1.1889** (0.4874)	-1.2074** (0.4967)
merged entity’s mean market share	-	0.0023 (0.0091)	-	-0.0011 (0.0091)	-	-0.0019 (0.0092)
Number of observations	107	107	107	107	107	107
Log likelihood	-55.8810	-55.8502	-52.5497	-52.5421	-54.1509	-54.1296
R-squared	0.1439	0.1444	0.1950	0.1951	0.1705	0.1708

**Note** – \* 10% significance level, \*\* 5% significance level and \*\*\* 1% significance level.

Table 3 provides the same Probit regressions as in table 2 except that the market share filter is set at 0%, 15% and 25%. As the table shows, the results are robust across these alternative thresholds.

### *Relation to other econometric literature on merger decisions*

This is not the first econometric study have used information from within published decisions. However, previous studies have investigated the market structural determinants of an intervention in a merger proposal and not the speed of agreement. An intervention may be a remedy, prohibition or referral to Phase II. They also focus

on a single market to characterise each merger in their datasets. Lindsay et al (2003) examine 245 mergers decided 2000-02 and find, not surprisingly, that high market shares and barriers to entry are the main determinants of an adverse decision. They also look for nationality effects, but find neither US nor Nordic ownership mattered. Bergman et al (2005) separate the decision to go to Phase II from the conditional decision to prohibit, given Phase II. Market share is important for both, particularly for the Phase II decision. The only other significant variable for prohibition is if the firm was a world leader. Entry barriers and fears of coordination are significant for Phase II referral. No effect was found to do with individual commissioners or firms from large EU member states, but US firms were less likely to be referred to Phase II.

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## **6. Conclusions**

Bargaining over remedies under the ECMR provides an unusual opportunity to model and test bargaining theory outside its usual realm of wage negotiation. In particular, the formal structure and need for evidence to support any decision allows a particularly simple way to model a bargaining process. The institutions provide a formal structure to offers and acceptance or rejection of offers, and probability of delay is easily calculated as are the probabilities of type 1 and type 2 errors in regulatory judgements. Moreover, the model permits relatively straightforward empirical testing. Using our database on EC merger remedy decisions, we find strong empirical support for the model of bargaining. Our results confirm that firms act strategically when making offers and that agreements in Phase I are likely to be excessive (type 1 error) when a relatively straightforward merger is being appraised, but are likely to be deficient (type 2 error) if the merger is relatively complex.

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