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Abstract

This paper aims to build and empirically evaluate a discrete choice model of merger remedies as a basis for policy analysis. The database consists of 229 merger cases accepted in Phase I or Phase II of the European merger process between 1990 and 2005. We focus on the following question: Which merging firms' characteristics lead the European Commission to decide whether to require conditional acceptance? Although a lot of empirical studies have been carried out these last years, ours is distinguished by at least two original features. First, we explore determinanting factors of the Commission's decisions with a neural network model differentiating cases accepted with or without remedies (either structural or behavioral). Secondly, we implement three multinomial logit models. We find that variables related to high market power lead more frequently to a remedy outcome, whatever the phase. Innovative industries such as energy, transportation and communications positively affect the probability of a behavioral remedy. Lastly, former Competition Commissioner Mario Monti's policy appears to be pro-remedy, *i.e.* seeking concessions from merging parties.

Keywords: Merger Remedies – Antitrust – European Commission – Discrete Choice Models – Self-Organizing Maps.
JEL Classification: K21, L40, D78.

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Introduction

In October 2005 the Antitrust Section of the European Commission (EC) published a long-awaited study that assessed the efficiency of merger remedies between 1996-2000, *i.e.* commitments imposed on the merging firms to get the operation accepted.[1] This study follows the one made by the U.S. antitrust agency – the FTC – that had stressed problems with divestitures.[2] Actually when a merger raises some anticompetitive concerns, the authority has the possibility of proposing conditional acceptance, *i.e.* the authority imposes commitments on merging parties as a condition to accept the merger. This means is called a remedy which has been traditionally distinguished into two basic forms: One addresses the market structure (structural remedies), the other the merged firm's behavior (behavioral remedies). Structural remedies generally involve assets divestitures (physical or intangible assets) by the merging firms. Also, new competitors can be created through the sale or licensing of assets if an existing competitor for some reason doesn't purchase divested assets. A behavioral remedy usually entails injunctive provisions that would manage or regulate the merged firm's post-merger business conduct. In some cases – often in high-tech markets – the competition concern may require both structural and conduct relief.[3]

The European report suggested that merger remedies had permitted more concentrations to be accepted but highlighted a series of flaws in their design and implementation.[4] The analysis was based on interviews with merging parties, competitors and trustees. Moreover, the European agency has to face recent questioning about the validity of its merger control. Often stigmatized for its tough decisions, the EC has been questioned by three annulments of its merger prohibitions by the Court of First Instance.[5] Thus, it seems appropriate to look into the motives of the EC's criteria. Does the authority decide in accordance with general economic principles and IO theory? Or does it adopt more of a case-by-case approach? In either case, the interesting question is the following: Do merging firms have the possibility of planning a better strategy that avoids high litigation costs or a devastating effect on their brand image? We'll see the answer is not straightforward.

Here we target a more technical analysis of factors that can influence the EC's decision-making process when facing an anticompetitive concern. As Monti (2003), former Competition Commissioner at the EC, claimed that "*the vast majority of the competition concerns that had arisen in merger cases had been addressed by means of divestitures*", researchers and practitioners had to cover the issue in deeper detail.

In order to estimate the relationship between merger remedy decisions and market

[1] *Merger Remedies Study*, DG COMP, European Commission, October 2005. See Kopke (2005) for a summary.

[2] *A Study of the Commission's Divestiture Process*, Federal Trade Commission, 1999.

[3] See Motta (2004).

[4] For instance, the scope of the divested business, the viability of the purchaser, and strategic behaviors between sellers and purchasers can raise serious concerns about the efficiency of some remedies.

[5] The famous Airtours/First Choice, TetraLaval/Sidel and Schneider/Legrand merger cases.

structure variables, as well as political variables, we built a database including 229 merger cases accepted in Phase I or in Phase II between 1990 and 2005.[6] In order to explore the database in detail, we first use Kohonen's maps issued from neural networks research. Then, we present main results of three multinomial logit (MNL) models.

The paper is organized as follows. Section 1 provides an overview of how economists have tried to evaluate the accuracy of antitrust agency decisions. Section 2 contains the description of the model and the database we built. Lastly, Section 3 reports the results.

1 How to measure antitrust agency's efficiency

In determining whether a proposed transaction is likely to substantially lessen competition, the antitrust agency has to address a number of economic issues, particularly the well-known tradeoff between market power and efficiency gain and the protection of consumers' interests.[7] This section overviews the main variables used by the authority when it faces a merger proposal.

Actually the first attempt at assessing the efficiency of a competition authority was Posner's seminal work (1970). He studied the correlation between business cycles and the number of cases filed to the Department of Justice (DOJ). He found some significant positively-correlated variables such as the GDP and the authority budget; the only negatively-correlated variable was the "war period".[8] Posner's work encouraged further empirical research and gave birth to a large number of studies.

1.1 Different approaches to assessing an antitrust authority

■ **Cost-benefit analysis**. The prolific empirical literature on antitrust began with the cost/benefit approach, which was first carried out by Long et *al.* (1973), Asch (1975), and Siegfried (1975). They were interested in quantifying welfare variations linked to antitrust regulation. Profit industries were classified by estimating the classic deadweight loss (Harbeger, 1954) due to market power. Costs mainly included litigation costs initiated by the government. They all used a basic model to assess

[6]Thus, the period covers the beginning of the new merger regulation passed in 2004. See, for instance, Lyons (2004) for further details about the procedure.

[7]As Competition Commissioner for the EU Ms. Neelie Kroes says "*Our aim is simple: to protect competition in the market as a means of enhancing consumer welfare and ensuring an efficient allocation of resources*". European Competition Policy – Delivering Better Markets and Better Choices. European Consumer and Competition Day, London, Sept. 5, 2005.

[8]The main limit of this study concerns its descriptive analysis. The author simply compared proportions and didn't use any statistical tests. In addition, no trend analysis or autocorrelation detection was implemented at all. In fact, the possibility of collecting more data and using more sophisticated methods that weren't available at that time would have permitted to extract – in a much more convincing way – the main determinants of the DOJ activity.

the monopolist's deadweight loss. For instance, Long et *al.* used DOJ data over the period 1945-1970. The authors performed a linear regression between filed cases and welfare losses, profit rates, outputs, and concentration ratios. They also dealt with determining the impact of concentration on the market. Results showed that when concentration rose, more cases were being filed against the given industry. However, the number of cases didn't increase at the same rate as market concentration, and even may have decreased above a certain threshold. Despite the large number of studies, this cost/benefit approach suffered from one major flaw: Assessing the monopolist's deadweight loss was rather inconvenient. The methodology failed to provide strong evidence. Nevertheless, one of Long's appealing results is that cases filed to the DOJ do not fit those Harbeger's model would provide. In other words, *ceteris paribus*, cases filed to the DOJ are not the ones that lead to higher welfare losses. This result is in the same vein of the public choice school; antitrust policy goal is not linked to the economist's conception of social welfare (McChesney et Shughart II, 1995).

■ **The discrete choice approach**. More recently econometrics and discrete choice modeling marked another milestone in antitrust methodology. More sophisticated models allow one to take into account a large range of economic variables and to test their significance. Coate et *al.* (1992) estimated a probit model of 70 FTC merger cases between 1982 and 1987.[9] Three variables of the U.S. Merger Guidelines appeared significant: barriers to entry, collusion, and efficiency gains. They showed efficiency considerations over the period didn't affect the authority's decision to accept or block a merger. They also found that political pressure from Congress was a significant factor. Khemani and Shapiro's work (1993) was close but looked at Canadian data. Market shares and concentration were the more important factors that explained authority's decisions in terms of concentration. Barriers to entry and foreign competition remained less significant. Weir (1992, 1993) studied the UK's merger decisions using a probit model, too. He found that post-merger market shares didn't influence the decision-making process but made antitrust competition less likely to accept hostile takeovers.

■ **Event study approach**. Lastly, event studies from the financial literature have been carried out with antitrust data.[10] Event studies are based on the market efficiency hypothesis (Fama, 1970), *i.e.* stock prices reflect complete information about business activity. A market model (Capital Asset Pricing Model) is estimated to study stock price reactions to merger announcements. In that type of model, stock price is proportional to market returns. According to Brady et Feinberg (2000)[11], merger control has a direct impact on individual company stock. With the same methodology, Aktas et *al.* (2004) analyzed market responses to the EC announcements. They showed that the market clearly reacted to the Commission's decisions and that the probability of its intervention was not linked to acquirer's nationality. However, if the authority intervenes, the market anticipates a more costly operation when the acquirer is a non-European firm. Another example is Duso et *al.* (2003) who used event study analysis

[9]The first paper using discrete choice modeling to assess an authority is Barton's (1979) which implemented a logit model to estimate the logics of Federal Communication Commission's decisions.

[10]For further readings on event study analysis, see MacKinlay (1997).

[11]Their sample includes 27 firms from the *Financial Times* magazine.

of stock data to evaluate European merger control in terms of political economy. They found that the protection of consumer surplus was not the only motive of the EC : The institutional and political environment did matter. Still, their data suggested that the Commission's decisions were not sensitive to firms' interests. Instead, results suggested that other factors – such as country and industry effects, as well as market definition and procedural aspects – did play significant roles. To sum up, a lot of work has been done with stock data from merging parties' competitors. Yet, we should interpret results with care because if the situation was so simple antitrust authorities would just look at stock exchange instead of carrying out a long and costly market analysis.

This brief survey reveals that competition authorities are not always guided by economic principles. Although it is well established that barriers to entry and market power are decision variables, other elements like political influences seem to interact too. We need to further investigate in order to stress which elements out of the economic sphere could be relevant for the European merger control.

1.2 The starting point of the study

Our paper follows three recent studies of European antitrust authorities' decisions: Bergman et *al.* (2005), Schinkel et *al.* (2006), and finally Duso et *al.* (2006). First, Bergman et *al.* deal with 96 merger cases between 1990 and 2004 (after sampling and removing incomplete data). The dependant variable is the type of decision. Contrary to our analysis, they study accepted *and* rejected merger decisions with logit modeling. They find that the probabilities of a Phase II request and of a prohibition of the merger increase with the parties' market shares. The probability also depends on barriers to entry and facilitating practices of collusion. No political influence affects the decision making process.[12] Barriers to entry appear to be strongly significant (at 1 % level). Sectors are relevant too (water and construction).

Schinkel et *al.* (2006) focus on antitrust cases (no merger cases). Their main contribution consists of an econometric analysis of EC's appeals decisions between 1964 and 2002. Their data cover all antitrust decisions by the EC up till 2002. In a first descriptive step, they investigate the EC fining policy and find that the European agency imposes highest fines to horizontal cases. This category has experienced the "*the fastest rise in average as well as sum of total fines*". In a second step, they use a binary probit model show that the notified case in which abuse of dominance plays a role are more likely to result in infringement. Commissioners matter, too. Secondly, they observe that the probability of going into appeal (for infringement cases) does depend on the level of fines imposed on the parties: the higher the fine the higher the probability of appeal. Lastly, unsurprisingly the number of parties also increases the likelihood of appeal.

[12]The authors assess political influence on the authority's decision-making with dummy variables such as commissioners and countries of origin. Janin et Menoni (2005) use French merger data and reach the same conclusions. Political factors have a low influence on French authority's final decisions.

Duso et *al.* (2006) use an event study to analyze the competitive outcome of merger remedies. Their sample includes 168 concentrations between 1990 and 2002. Two specific days are relevant in their analysis: *(i)* the announcement day, *i.e.* stock prices provide information about whether the merger is likely to create anticompetitive concerns; *(ii)* the day when the EC makes its decision, *i.e.* stock prices reflect the outcome of the bargaining process between the agency and the parties. First, the authors assess the weighted average abnormal returns of all firms (insiders/outsiders), which give a measure of merger profitability. Then, using regression techniques they estimate the degree of effectiveness of an antitrust action. Their results show that merger remedies are not always appropriately imposed. Also, they conclude that the market can predict remedies' effectiveness when applied in Phase I. However, they find that remedies appear to be less effective in Phase II maybe due to the increased merging firms' bargaining power during at the last stage of the merger review.

Two elements distinguish this paper. First, to our knowledge, except for Duso et *al.* (2006) in a context of an event study analysis, this is the only econometric work that differentiates structural and behavioral remedies. And our database covers fifteen years, *i.e.* the whole period of the first merger regulation and one year of the new reform. The other originalities are an appealing data analysis and the choice of a *multinomial* logit model.

2 Modeling the merger remedy process

2.1 Model specification

Discrete choice models have been largely used in various research areas: transportation, economics, marketing, behavioral sciences, *etc.*[13] They have proved their efficiency in estimating individual choice probabilities with a set of mutually exclusive alternatives. These models are usually consistent with random utility theory, *i.e.* individuals are supposed to choose the alternative associated with the maximum utility.

In modeling remedies in the European merger control, we use a multinomial logit model (MNL). We first assume that the authority can choose from a set of alternatives: structural remedies, behavioral remedies, both remedies or neither of them. At the i-th merger proposal, it receives utility from each alternative j such as

$$U_{ij} = \boldsymbol{\beta}\mathbf{x}_{ij} + \epsilon_{ij} \tag{1}$$

where $\mathbf{x}$ represents a vector of covariates, such as merging firms' characteristics (market shares, location *etc.*) and various market indicators (sector, barriers to entry, *etc.*). $\boldsymbol{\beta}$ is the respective coefficient vector. The authority will choose an alternative that maximizes utility. When there are m choices, the probability of choice j is

[13]For a review of discrete choice models, see Train (2003). A classic econometric textbook is provided by Greene (2003).

$$Pr(y_i = j) = Pr(U_{ij} > U_{ik}), \quad \forall\ j \neq k, \quad j = 1, 2, \ldots, k, \ldots\ m. \tag{2}$$

The dependent variable in our analysis is the type of acceptance made by the antitrust authority when faced with a merger proposal. "*Phase I without remedy*" ($y = 0$) is treated as a reference category. If we assume that all ϵ_{ij} of the m choices are independent, identically distributed with type I extreme value (Gumbel) distribution, McFadden (1973) has shown that the multinomial logit model has a closed-form solution. The maximum likelihood estimation of the model is straightforward. The probability of choosing an alternative j among m can be written such as

$$Pr(y_i = j) = \frac{e^{x_i \beta_j}}{1 + \sum_{k=1}^{m} e^{x_i \beta_k}}, \quad \forall\ j = 1, 2, \ldots, m\,. \tag{3}$$

The marginal effects, which are partial derivatives of probabilities P_j with respect to the set of characteristics, are calculated from multinomial logit results following the equation below:

$$\frac{\partial P_j}{\partial \mathbf{x_i}} = P_j \left(\beta_j - \sum_{k=1}^{m} P_k \beta_k \right), \quad \forall\ j = 1, 2, \ldots, m\,. \tag{4}$$

The sign and magnitude of this marginal variable have no direct relationship with any specific coefficient (Greene, 2003). Elasticities of probabilities can also be computed.

$$\eta_j = \frac{\partial P_j}{\partial \mathbf{x_i}} \frac{\mathbf{x_i}}{P_j} = \mathbf{x_i} \left(\beta_j - \sum_{k=1}^{m} P_k \beta_k \right), \quad \forall\ j = 1, 2, \ldots, m\,. \tag{5}$$

The restriction of choosing a MNL is that we do not take into account the length of the merger procedure. Imposing a remedy in Phase I or in Phase II is the same in such setting. The MNL is based on a strong hypothesis: the ratio of the probabilities of any two alternatives is independent from the choice set. This property is called the "*independence of irrelevant alternatives*" (IIA), which may be a limitation in some practical applications. Here, our data successfully passed the Hausman and McFadden test, which was not surprising due to the type of data.

2.2 Database

Between 1990 and 2005, the EC receives 2,961 merger notifications. In respect to our initial objective – studying merger remedies – we focus only on accepted cases (both phases with and without remedies). Phase I remedies concern Art. 6.2 of the EC Merger Regulation whereas Phase II remedies concern Art. 8.2.

Our database consists of 229 accepted merger cases between February 1991 and December 2005 (see table 1). Data were mostly collected from the EC's online resources[14]. The sample doesn't account for most cases unconditionally accepted in Phase I (Art. 6.1(b)) because they were not available[15]. These cases largely correspond to merger decisions which don't raise serious doubts about their compatibility with the common market. We only obtained 15 merger reports from this category[16].

Table 1: Case population and net sample (1990-2005)

	Population	*Sample*
Number of notified cases	2,961	
Number of refused cases	211	
(withdrawn, referred or blocked)		
Number of accepted cases	2,750	**229**
PHASE I ACCEPTANCE		
accepted without remedy	2,513	15
accepted with remedies	134	115
Total Phase I	2,647	**130**
PHASE II ACCEPTANCE		
accepted without remedy	28	27
accepted with remedies	75	72
Total Phase II	103	**99**

Out of 2,961 proper merger notifications, 83% were accepted in Phase I. Overall, the authority imposed 209 remedies (134 + 75). The number of remedies increased over the period. On one hand, the Commission tends to impose remedies more often in Phase I, which shows a faster analysis when low-cost remedies are available. On the other hand, when the case is more complex, Phase II investigations start and the "*stop the clock*" option enables merging parties to get more time to propose adapted remedies.

Detailed information was not available for 22 of the remedies. Consequently, the sample consists of 130 cases in Phase I and 99 cases in Phase II. Overall, 54% of remedies in Phase I were structural, 31% were behavioral, and 15% mixed both types of remedies (see table 2). The conditioning of merger project with assets' divestiture prevails in Phase I. When we look at Phase II remedies, 36% were structural, 25% were behavioral, and 39% mixed both types of remedies. Surprisingly, a mix of both types is most represented in Phase II. A reason may be that the complexity of

[14]See http://europa.eu.int/comm/competition/mergers/cases/.

[15]The European Commission Web site doesn't even list the cases.

[16]Actually these 15 cases contain slight commitments but we didn't consider them as remedies because they were only "*[. . .] restrictions directly related and necessary to the implementation of the concentration*" (Art. 6.1(b)).

Table 2: Types of remedies analyzed (1990-2005)

	Structural	*Behavorial*	*Both*	*Total*
Phase I	62	36	17	115
(percentage of Phase I)	(54%)	(31%)	(15%)	
Phase II	26	18	28	72
(percentage of Phase II)	(36%)	(25%)	(39%)	
Total	88	54	45	187

Phase II cases usually requires a more sophisticated remedy package to ensure that the anticompetitive concern is resolved.

We only deal with one relevant market per case. The choice of that market depends on the potential anticompetitive concern. Each time we choose the narrowest market where competition could be hurt the most (Bergman et *al.*). Due to secret business considerations, market shares are not easily available.[17] Thus, we use 25% range dummy variables to collect them. We also create dummy variables to code firms' location (see table 3) and sector information (see table 4). Also, the merged entity's worldwide turnover is reported from either EC decisions or business press. The appendix lists every regressor variable and details the coding scheme.

3 Results

First we implement a neural data analysis in Section 3.1. Then, results from the multinomial logit model are provided in Section 3.2.

3.1 Mapping the choice of a remedy

Here Self-Organized Maps (SOM) provide a preliminary analysis of the data. SOMs – a type of artificial neural network (ANN) – offer an original data analysis.[18] More precisely, we use one specific type of SOM, Kohonen's maps, which are used to perform tasks such as data exploration, classification, forecasting and optimization (Kohonen, 2000). Properties of Kohonen's maps are twofold. First, the dimensionality number of data is shrunk, as it is in projection methods (principal components analysis), and input data are projected onto a discrete space where topological aspects of observations space are preserved. Secondly, similar inputs are represented by one prototype

[17] Actually market delineation or market share estimations are not completely objective and may be argued between merging parties and the competition authority.

[18] ANNs simulate the activity of the human brain. Detailed discussion about ANNs is beyond the scope of this paper, but curious readers are invited to read Haykin (1999).

vector – a node – on the map that is surrounded by other prototypes related to neighboring inputs. With an unsupervised algorithm, such quantification leads to classify input data. Kohonen's maps appear straightforward: Two "cases" that share close characteristics are represented by two neighboring nodes. By interpreting the distance between nodes, we make explanations more intuitive. Several studies underline that SOM outperforms more traditional approaches (Cottrell et Rousset, 1997). Kohonen's maps not only improve projection and classification, but also can handle non linearity and low-frequency events, which is useful in our case.

We used the Som ToolBox[19] package to generate the maps (see the appendix). The comparison of the U-matrix (see figure 6) – where the eight alternatives are represented – and the influence of one variable in the activation of nodes (see figures 1-5) provides relevant information. First, vertical mergers (VMERGER) often lead to a Phase I decision. In practice, if a anticompetitive concern is raised, antitrust authorities privilege behavioral remedies when vertical relations are concerned. Those commitments provide other market participants with access to key assets such as infrastructure or technology (Alcatel / Thomson, 1998).

Secondly, if we look at firms' countries of origin, the maps show that merger cases involving French firms usually lead to a remedy outcome. The country of origin also matters when U.S. firms are concerned. Mergers involving American acquired firms require structural remedies in Phase I (Monsanto / Pharmacia & Upjohn, 2000; United Airlines / U.S. Airways, 2001). On the acquired side, not surprisingly, cases involving several firms of various nationalities (CREW-R) are correlated with remedy decisions; more specifically, behavioral remedies. And when Deutch firms are being acquired (HOL-D), the authority often requires structural outcomes in Phase I (Syngenta CP / Advanta, 2004).

Another interesting result is the influence of merging firms' turnover. Structural remedies are often used when dealing with high post-merger turnovers (Elf Atochen / Rütgers, 1994 ; Carrefour / Promodès, 1999 ; AT&T / Mediaone, 1999). A size effect may play a role in the decision (TURNOVER and CREW-R).

Lastly, sectors play a significant role in shaping a remedy such as in the "Electricity, gas and water supply" industry. Granting access is the most common remedy in use for the energy sector (Total / Gaz de France, 2004). This sector is characterized by high fixed costs, which make it more difficult to impose structural remedies on its firms. And if structural remedies are possible, behavioral remedies are also included in the remedy package to make sure the asset will remain viable once the concentration is done (Verbund / Energy Allianz, 2002).

[19]See http://www.cis.hut.fi/projects/somtoolbox/.

3.2 The multinomial logit model

Tables 5, 7 and 9 present the estimated coefficients of the three MNL models[20] based on the general specification presented in equation (3). The models could not be computed with the whole set of regressors because of multicolinearity with dummy variables. The previous neuronal analysis and significant coefficients helped us screen a more restrained set of reasonable variables.

As Greene underlines, "*the coefficients in this model are difficult to interpret*" (2003, p. 722). Consequently, we adopt the following methodology. We first estimate the models and select one by looking at three criteria: regressor significance, percentage of correct predictions, and the pseudo R^2. We then compute elasticities of probabilities using the formula in (3) and comment on their sign and magnitude to find the main determinants of each alternative. Tables 6, 8 and 10 report the elasticities.

3.2.1 Model #1: Conditioning a merger

In the first model, we use a four-alternative specification of the empirical model, based on the differences between conditional acceptances or no remedies and discrimination by phase. Market power variables only appear significant for acquired firms. Low and medium market shares of acquired firms positively determine remedy decisions in Phase I (ACQUID1, ACQUID2). Size effect variables don't appear to be good predictors for this model because neither post-merger turnover (TURNOVER) nor world leader (WORLDLEADER) variables are below a 10% significance level.

The influence of "political variables" is less standard in earlier studies but more in the line of recent commentaries in the media. Former European Antitrust chief Mario Monti appears strongly significant at the 1% level. His work had an important role in the choice of a conditional acceptance in Phase I (MONTI).[21] Unlike Bergman et *al.* (2005), we found that his role as the head of the Antitrust Section undoubtedly affected merger decisions. Although his influence was largely stressed in the media, it was not found in previous empirical works. A focus on remedies seems to unveil his impact, whereas the simple modelization of the acceptance/rejection process hadn't underlined it. Surprisingly, the French nationality of the acquirer firm (FRA-R) is another political variable that is correlated with remedy decisions in Phase I (Hoechst / Rhône Poulenc, 1999; Masterfood / Royal Canin, 2002; Alcan / Pechiney, 2003). Lastly, Germany turns out to be significant, too. The German nationality of the acquirer (GER-R) positively influences a Phase II decision (with or without remedies).

Market variables are also significant and present expected signs. As several studies show, barriers to entry – significant at least at the 5% level – are one indicator of a remedy outcome (ENTRY). Precisely, barriers to entry in the relevant market are

[20] All estimations were carried out using Limdep software.

[21] In the press, Monti was dubbed as "Super Mario" when he blocked several mergers such as the GE/Honeywell case (see, for instance, "Super Mario: EU's Antitrust Czar isn't Afraid to Say No", *Wall Street Journal*. October 2, 2000) or when he investigated Microsoft bundling practices.

more likely to condition a merger in Phase II. Another interesting result is that a group of firms being acquired positively influences the authority's acceptance without any remedies (Crew-d).

If we now look at the various industry sectors, elasticities show that transportation and communications sectors positively impact the probabilities of acceptance in Phase I (Sectori). Next, mergers taking place in the retail trade sector also correlate with Phase I decisions, but without any remedies (Sectorg).

The goodness-of-fit of this model seems good enough. The overall level of correctly classified decisions is more than 57%.

3.2.2 Model #2: The full merger process

Our database allows us to refine the previous model by discriminating remedies in three alternatives: structural, behavioral, and both. Thus, model #2 consists of eight alternatives (Phase I / Phase II, No remedy / Structural / Behavioral / Both remedies). First of all, elasticities of probabilities indicate that a change in barriers to entry positively affects the probability of a behavioral remedy in Phase II. Actually, as soon as concerns about entry are raised, the merger is always accepted with commitments from the merging parties.

Results also indicate that a merger in communications or transportation industries (Sectori) is likely to be accepted in Phase I (with any or access remedies). The approach stresses the importance of high technology markets in designing behavioral remedies (licences, industrial property rights). Imposing divestitures on an innovative firm is sometimes counterproductive because merger efficiencies matter.

In regards to market shares, the acquired firm's shares are still relevant, mostly in Phase I (Acquid1, Acquid2). Also, high market shares of acquirers negatively impact behavioral remedies (clearer for Acquir2 than Acquir3). When facing large acquirers, structural remedies are likely to be preferred to access remedies. That result differs from the model #1 result.

Compared to the first model, Fra-r, Monti and Sectori play the same role in Phase I. Plus, the model performs well by correctly predicting the importance of structural relief as highlighted in the "*Merger Remedy Study*" (*op. cit.*). The pseudo R^2 for matching remedy choice, adjusted for degrees of freedom, is .15, and the parameter estimates are reasonable. The percentage of correct prediction is 30%. The value is rather low because we use eight alternatives. The model correctly predicts the choice of structural and behavioral remedies in Phase I but cannot predict mixed remedies, in either Phase I or in Phase II of the merger process.

3.2.3 Model #3: Integrating mixed remedies

Because of prediction problems encountered with alternative "both remedies" in model #2, we adopt a different model specification. We reclassify remedies in two groups in-

stead. As behavioral remedies are often included in divestitures packages, we integrate the mixed alternatives (structural and behavioral) into the structural ones.

In many respects results are similar to model #2 results. HMERGER is mostly significant at the 1% level. As shown in table 10, a horizontal merger has a positive effect on the probability of acceptance without any remedies. ENTRY still contributes to a remedy decision in Phase II (rather bahavioral).

Next, the choice of a structural remedy in Phase I is relatively unresponsive to changes in high market shares (ACQUIR2, ACQUIR3). That contrasts with its strong response to low market shares such as ACQUID1. This is not surprising because mergers of high market share firms are more likely to be cleared in Phase II investigations.

As in model #2, the probability of a structural remedy in Phase I significantly increases if the acquired company is French (FRA-R). Few French cases were accepted in Phase II of the merger process. More often, commitments are negotiated beforehand.

Lastly, former Competition Commissioner Mario Monti still has the same role in this last model: He may encourage remedy decisions in Phase I in order to shorten the decision-making process or to save authority's resources (MONTI).

We have partially reached the expected objective for model #3. Compared to model #2, the percentage of correct predictions rose by 7 percentage points. But we still encounter prediction problems as soon as an alternative includes behavioral relief. This type of remedy would be difficult to predict through our political or market variables. We would like to emphasize to our reader that our priority is to highlight some characteristics that cause the European agency to require conditional acceptance.

Several hypotheses can be proposed to figure out the low predictive power of our models. First, we faced a sampling problem. The acceptance without remedy in Phase I was underrepresented. We couldn't overcome the bias with our lack of information. A sampling choice method was not carried out because we lacked so much information. And the use of a MNL may be not an optimal choice if we consider the sequential aspect of the merger process.[22] A modelization with nested choices could have been more appropriate. Nonetheless, the absence of post-merger data relative to the choice of a given remedy kept us from selecting this structure. Finally, we shouldn't forget that the choice of regressors is important and the lack of information about quantitative post-merger data and welfare effects cannot be ignored.

Conclusion

The paper investigates the use of merger remedies by the EC. After an overview of the main studies that have assessed antitrust agencies' efficiency, we built a new database for 1990-2005 and analyzed the determinants of remedies with a multinomial logit modelization.

[22]We computed a non-linear version of the MNL (Box-Cox transformation) without any more powerful outcomes.

In accordance with industrial and antitrust economic theory, we found that variables related to high market power led more frequently to a remedy outcome, whatever the phase. Of particular interest were the characteristics of acquired firms. The market power of the acquired firm determines the decision to launch Phase II investigations that often end up with a structural remedy.

The approach stresses the importance of a size effect in the decision-making process: Variables that reflect merging parties' size encourage the Commission to opt for a remedy outcome. Actually, firms with a high turnover are likely to be forced to divest a part of their business as a condition to merge. Although this result didn't appear with MNL modelization, the result of Kohonen's maps enables us to highlight this aspect. Also, mergers involving several acquirers end up being conditioned with an access remedy to the rival firms.

Three sector variables influence the authority: energy, communications and retail trade. High-tech or know-how intensive sectors, such as energy and communications, often invoke remedy decisions due to the concentration of the sector (*economies of scale*). Access remedies are the most used in those two sectors to make sure intellectual property rights (IPRs) won't foreclose competitors. The retail trade sector positively affects an outright acceptance.

Results also support that Mario Monti had an effect on the shape of the remedy decisions. This is something new. So far, several studies couldn't have detected his influence on a merger being accepted or blocked. It is noteworthy that the remedy approach sheds some new light on the issue. Countries of origin also reinforce the political aspect of the decisions since U.S. and French acquirers lead to a merger decision with commitments.

All things considered, the paper stresses the main criteria of conditioning a merger. However, the predictive power of the models is not high enough to handle all types of merger outcomes. This work is a guideline and complement to more descriptive analyses such as the one released by the European Commission last October. A case-by-case basis is still necessary despite the understaffed antitrust authority. Further research could evaluate the cost of a remedy. This new information would permit a more complex modelization of the merger process.

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Appendix

Regressors used in the model

Most of regressors are dummy variables.

Acquid1: 1 if the acquired firm's market share range is $[0, 25\%[$, 0 else.
Acquid2: 1 if the acquired firm's market share range is $[25\%, 50\%[$, 0 else.
Acquid3: 1 if the acquired firm's market share range is $[50\%, 75\%[$, 0 else.
Acquid4: 1 if the acquired firm's market share range is $[75\%, 100\%[$, 0 else.
Acquir1: 1 if the acquirer's market share range is $[0, 25\%$ [, 0 else.
Acquir2: 1 if the acquirer firm's market share range is $[25\%, 50\%[$, 0 else.
Acquir3: 1 if the acquirer firm's market share range is $[50\%, 75\%[$, 0 else.
Acquir4: 1 if the acquirer firm's market share range is $[75\%, 100\%[$, 0 else.
Crew-d: 1 if the acquired consists of several firms, 0 else. This variable can reflect some bargaining power.
Crew-r: 1 if the acquirer consists of several firms, 0 else. This variable can reflect some bargaining power.
Entry: 1 if entry considerations are claimed, 0 else.
Fra-d: 1 if the acquired firm's headquarters are located in France, 0 else.
Fra-r: 1 if the acquirer's headquarters are located in France, 0 else.
Ger-d: 1 if the acquired firm's headquarters are located in Germany, 0 else.
Ger-d: 1 if the acquirer's headquarters are located in Germany, 0 else.
Hmerger: 1 for a horizontal merger, 0 else.
Hol-d: 1 if the acquired firm's headquarters are located in the Netherlands, 0 else.
Hol-r: 1 if the acquirer's headquarters are located in the Netherlands, 0 else.
Inter-d: 1 if the acquired firm's is an international holding, 0 else.
Inter-r: 1 if the acquirer is an international holding, 0 else.
Jvmerger: 1 for a joint venture, 0 else.
Monti: 1 if Mario Monti was the European Competition Commissioner, 0 else.
Other-d: 1 if the acquired firm's headquarters are located in another European country, 0 else.
Other-r: 1 if the acquirer's are located in another European country before, 0 else.
Scan-d: 1 if the acquirer's headquarters are located in Scandinavia, 0 else.
Scan-r: 1 if the acquirer's headquarters are located in Scandinavia (including Denmark, Sweden, Norway and Finland), 0 else.
Sectora to Sectoro: 17 dummy variables that describe activity sectors. We used the European commission's classification (Nace codes, see table 4). We removed Sector H, Sector M, Sector P, and Sector Q since no cases entered those categories.
Turnover: this is the worldwide turnover of the merged entity (expressed in $ billions).
Uk-d: 1 if the acquired firm's headquarters are located in the United Kingdom, 0 else.
Uk-r: 1 if the acquirer's headquarters are located in the United Kingdom, 0 else.
Us-d: 1 if the acquired firm's headquarters are located in the United States, 0 else.
Us-r: 1 if the acquirer's headquarters are located in the United States, 0 else.
Vmerger: 1 for a vertical merger, 0 else.
World: 1 if the merger involves a world leader firm, 0 else.

Table 3: Merging firms' countries of origin

	Acquirer firms	*Acquired firms*
FRANCE	17.2%	11.9%
GERMANY	18.0%	20.8%
INTERNATIONAL	7.2%	5.8%
THE NETHERLANDS	7.2%	8.4%
OTHER EUROPEAN COUNTRIES	12.4%	18.6%
SCANDINAVIA	10.4%	8.8%
U.K.	10.4%	12.8%
U.S.	17.2%	12.8%

Table 4: Merging firms' sectors

NACE Code	*Sector*	*Frequency*	*Percentage*
Sector A	Agriculture, hunting and forestry	3	1.31%
Sector B	Fishing	-	-
Sector C	Mining and quarrying	4	1.75%
Sector D	Manufacturing	142	62.01%
Sector E	Electricity, gas and water supply	14	6.11%
Sector F	Construction	2	0.87%
Sector G	Wholesale and retail trade	4	1.75%
Sector H	Hotels and restaurants	1	0.44%
Sector I	Transport, storage and communication	39	17.03%
Sector J	Financial intermediation	9	3.93%
Sector K	Real estate, renting and business activities	2	0.87%
Sector L	Public administration and defence	1	0.44%
Sector M	Education	-	-
Sector N	Health and social work	2	0.87%
Sector O	Other community, social and personal service activities	6	2.62%
Sector P	Activities of households	-	-
Sector Q	Extra-territorial organizations and bodies	-	-
TOTAL		229	1

Table 5: MNL coefficient estimates (model 1)

Variables	Phase I remedies	Phase II without remedy	Phase II remedies
ACQUID1	3.7239***	3.3726***	2.6428**
	(1.04)	(1.11)	(1.05)
ACQUID2	2.5634**	1.8446*	1.8526*
	(1.00)	(1.10)	(1.01)
CREW-D	-4.1426**	-2.7001	-4.8467**
	(1.92)	(2.26)	(2.17)
ENTRY	2.0311**	2.0614**	2.8287***
	(.85)	(.93)	(.86)
FRA-R	2.7964**	1.4773	2.2860*
	(1.23)	(1.43)	(1.25)
GER-R	-.0361	1.9470**	1.1964
	(.90)	(.93)	(.87)
HMERGER	-2.9953***	-4.2529***	-2.7440**
	(1.08)	(1.14)	(1.08)
MONTI	3.7924***	4.2012***	4.2012***
	(1.37)	(1.43)	(1.39)
SECTORG	-4.5782**	-2.9470	-4.1674**
	(2.07)	(1.91)	(1.88)
SECTORI	-.6435	-1.9235**	-1.6383**
	(.78)	(1.04)	(.83)
Pct. Correct	57.64		
Pseudo R^2	0.18		

$*$ Note: Standard errors are in parentheses. *, **, *** represent significance at the 10%, 5% and 1% level, respectively.

Table 6: Averages of individual elasticities of probabilities (model 1)

Variables	Phase I without remedy	Phase I remedies	Phase II without remedy	Phase II remedies
ACQUID1	0	.3418	.1316	-.3050
ACQUID2	-.6697	.1474	-.0817	-.0791
CREWD	.0691	-.0213	.0102	-.0367
ENTRY	0	-.1263	-.1112	.2707
GERR	-.1963	-.2034	.1863	.0388
FRAR	-.4646	.0605	-.1872	-.0354
HMERGER	2.0930	-.1699	0	.0200
MONTI	0	.1126	-.2626	-.0466
SECTORG	.0511	-.0289	-.0004	-.0217
SECTORI	.1443	.0347	-.1833	-.1347

Table 7: MNL coefficient estimates (model 2)

Variables	S1	B1	S1/B1	No S2/B2	S2	B2	S2/B2
ACQUID1	3.8598***	3.2202***	2.5674**	4.0804***	1.9743	2.6055***	2.888**
	(1.15)	(1.17)	(1.23)	(1.21)	(1.23)	(1.23)	(1.19)
ACQUID2	3.0952**	2.6081**	1.7068	3.0337**	2.0765*	1.9479	2.5774**
	(1.22)	(1.24)	(1.33)	(1.3)	(1.29)	(1.35)	(1.26)
ACQUIR2	-0.731	-1.8067**	-0.6287	-0.6688	-0.1718	-1.8246*	-1.7961**
	(0.87)	(0.93)	(0.97)	(0.94)	(0.94)	(1.04)	(0.93)
ACQUIR3	-1.3812	-1.4135	-1.2096	-1.5088	-1.886	-1.4627	-3.6944**
	(1.11)	(1.12)	(1.26)	(1.25)	(1.33)	(1.23)	(1.48)
ENTRY	1.8414**	1.1104	0.9876	1.7496**	1.8218**	3.06***	2.3674***
	(0.78)	(0.82)	(0.89)	(0.84)	(0.83)	(0.92)	(0.83)
FRA-R	1.5618*	1.7543*	1.9488**	0.5434	0.9745	2.25	0.3582
	(0.95)	(0.97)	(1.01)	(1.17)	(1.04)	(1.06)	(1.16)
HMERGER	-3.2778***	-2.6336***	-2.803***	-4.1073***	-2.3684**	-3.5344***	-2.4976**
	(0.98)	(1.01)	(1.06)	(1.03)	(1.04)	(1.04)	(1.03)
MONTI	3.6266***	3.2668***	3.3351***	3.1941***	3.2168***	2.854**	3.4373***
	(1.17)	(1.18)	(1.22)	(1.21)	(1.2)	(1.25)	(1.2)
SECTORI	-1.0466	0.0135	-0.9761	-1.8944*	-1.7537*	-1.953*	-1.3319
	(0.82)	(0.81)	(0.96)	(1.05)	(1.04)	(1.07)	(0.92)
Pct. Correct.	30.13						
Pseudo R^2	0.12						

$*$ Note: Standard errors are in parentheses. *, **, *** represent significance at the 10%, 5% and 1% level, respectively.

Table 8: Averages of individual elasticities of probabilities (model 2)

Variables	No S1/B1	S1	B1	S1/B1	No S2/B2	S2	B2	S2/B2
ACQUID1	0	.4668	.0842	-.3064	.5988	-.6612	-.2836	-.1146
ACQUID2	-.7804	.2063	.0510	-.2363	.1867	-.1184	-.1594	.0412
ACQUIR2	.3318	.0222	-.4335	.0655	.0485	.2590	-.4411	-.4290
ACQUIR3	.2095	-.0016	-.0066	.0246	-.0211	-.0788	-.0141	-.3552
ENTRY	-.9275	-.0108	-.3747	-.4358	-.0565	-.0205	.5959	.2511
FRA-R	-.2827	.0106	.0467	.0832	-.1806	-.0997	.1398	-.2154
HMERGER	2.0666	-.4096	.0770	-.0509	0	.2774	-.6035	.1798
MONTI	0	.1509	-.0393	-.0032	-.0777	-.0656	-.2574	.0508
SECTORI	.1300	-.0483	.1323	-.0363	-.1927	-.1687	-.2026	-.0969

Table 9: MNL coefficient estimates (model 3)

Variables	Phase I structural remedies	Phase I behavioral remedies	Phase II without remedies	Phase II structural remedies	Phase II behavorial remedies
ACQUID1	4.0095***	3.4814***	4.0503***	3.0663**	2.6856**
	(1.27)	(1.32)	(1.27)	(1.21)	(1.27)
ACQUID2	3.2961***	2.9237**	3.0451**	3.0618**	2.1503
	(1.27)	(1.32)	(1.35)	(1.27)	(1.39)
ACQUIR2	-.5743	-1.7999**	-.5097	-.9240	-1.7162*
	(.88)	(.95)	(.95)	(.89)	(1.05)
ACQUIR3	-1.5609	-1.5035	-1.8285	-3.1498***	-1.8220
	(1.09)	(1.11)	(1.23)	(1.21)	(1.22)
CREW-D	-3.9914**	-3.1609*	-2.4426	-4.2426**	-3.5616
	(1.85)	(1.90)	(1.95)	(2.01)	(1.00)
ENTRY	1.6514**	1.2025	1.5642**	2.1237***	2.8215***
	(.78)	(.83)	(.85)	(.79)	(.90)
FRA-R	2.3517**	2.3848**	1.1522	1.4067	2.7904**
	(1.11)	(1.14)	(1.30)	(1.16)	(1.21)
HMERGER	-3.2722***	-2.8936***	-4.2186***	-2.5110**	-3.7151***
	(1.04)	(1.08)	(1.09)	(1.04)	(1.10)
MONTI	3.9473***	3.6107***	3.4107***	3.7163***	3.1806**
	(1.26)	(1.28)	(1.30)	(1.27)	(1.33)
Pct. Correct.	37.12				
Pseudo R^2	0.14				

$*$ Note: Standard errors are in parentheses. *, **, *** represent significance at the 10%, 5% and 1% level, respectively.

Table 10: Averages of individual elasticities of probabilities (model 3)

Variables	Phase I without remedies	Phase I structural remedies	Phase I behavioral remedies	Phase II without remedies	Phase II structural remedies	Phase II behavorial remedies
ACQUID1	0	.3603	.0443	.3846	-.2040	-.4318
ACQUID2	-.9227	.1280	.0093	.0480	.0533	-.2372
ACQUIR2	.3189	.0756	-.4435	.1030	-.0725	-.4081
ACQUIR3	.2450	.0064	.0152	-.0345	-.2364	-.0335
CREW-D	.0604	-.0267	-.0086	.0071	-.0322	-.6299
ENTRY	-.8977	-.0756	-.2991	-.1190	.1595	.5069
FRA-R	-.3967	.0449	.0511	-.1803	-.1326	.1273
HMERGER	2.1572	-.3149	-.0289	0	.2602	-.6494
MONTI	0	.1356	-.0423	-.1480	.0135	-.2695

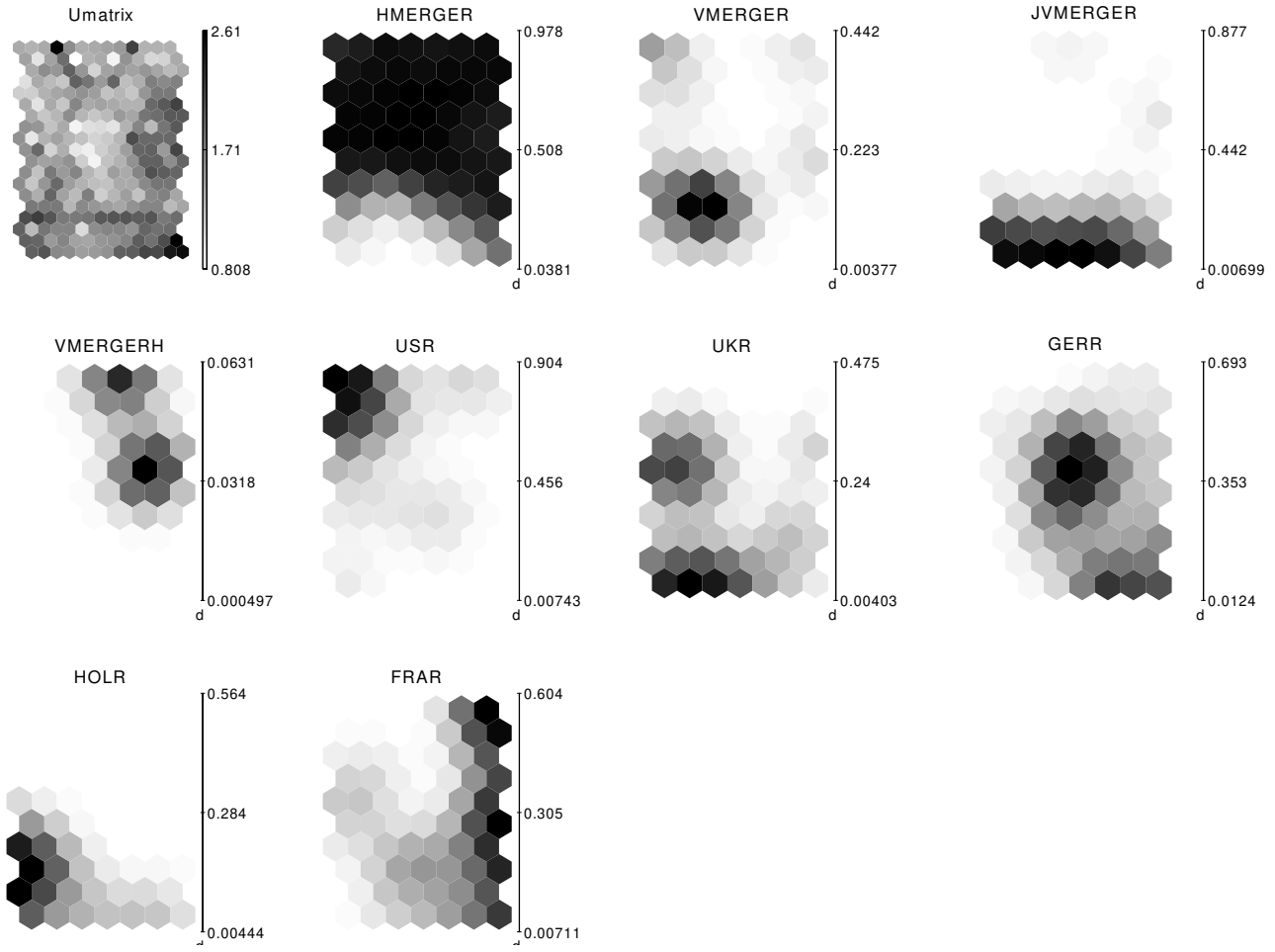

Figure 1: U-matrix and component planes for the EC merger data set (part 1)

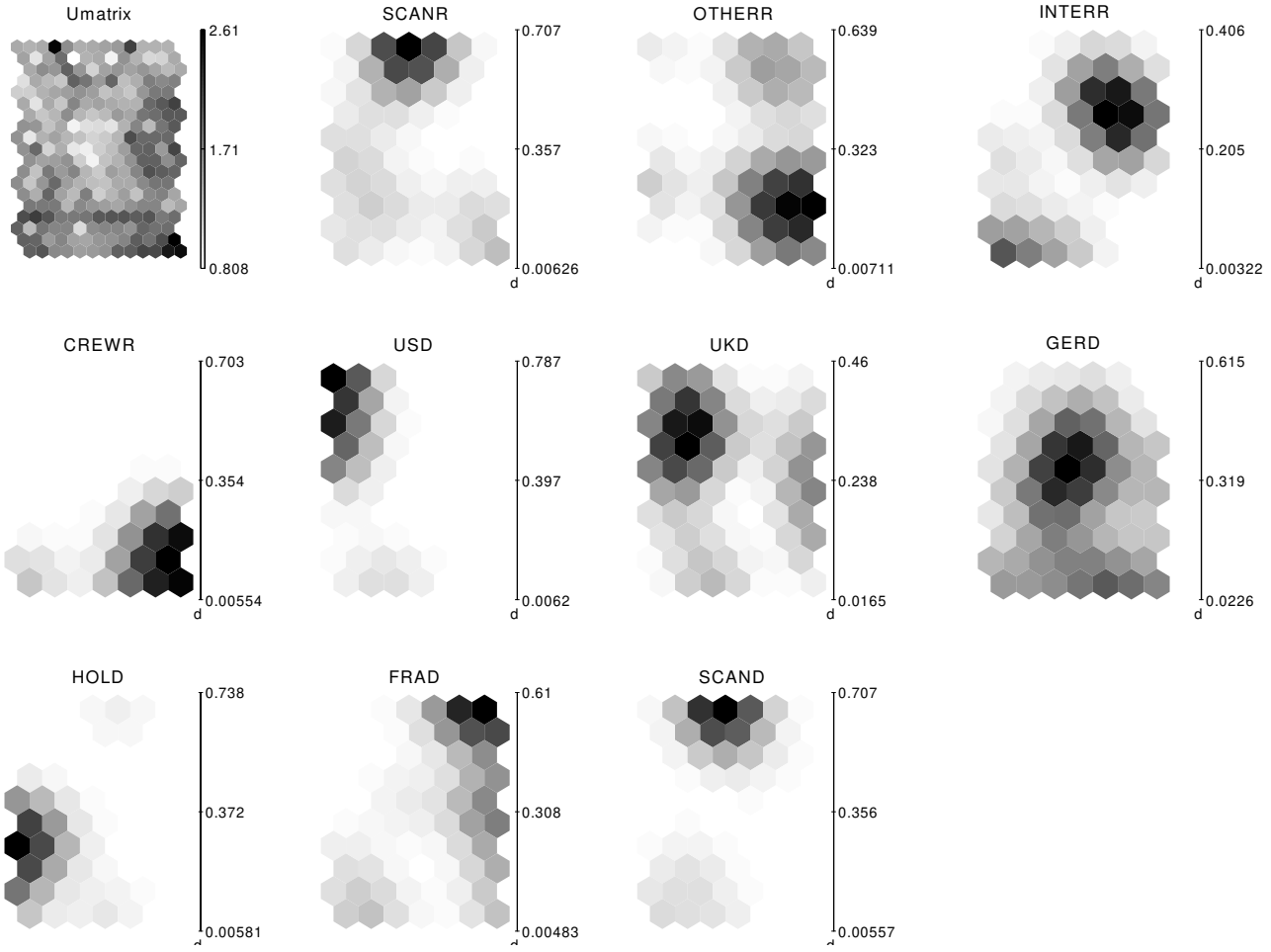

Figure 2: U-matrix and component planes for the EC merger data set (part 2)

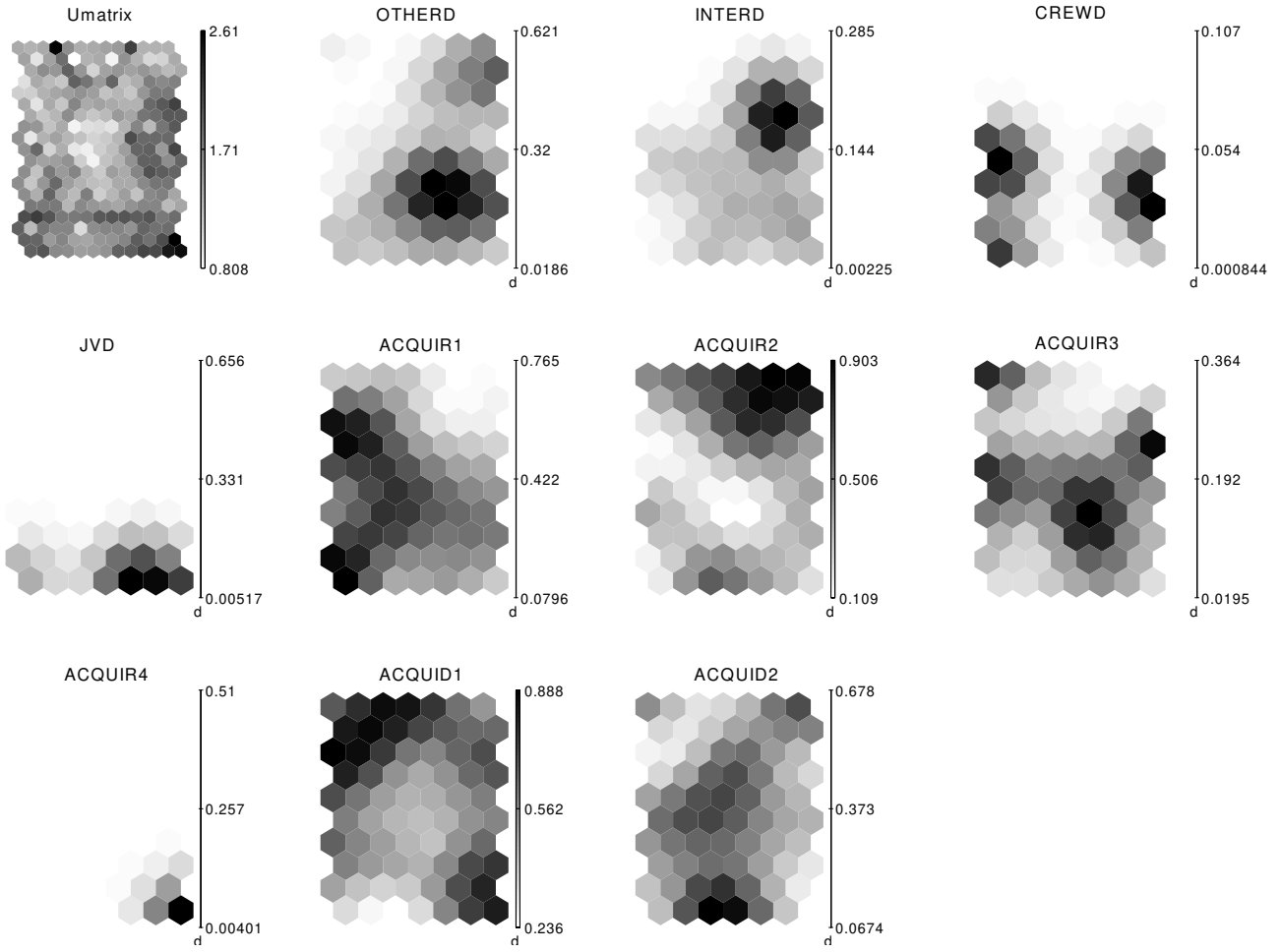

Figure 3: U-matrix and component planes for the EC merger data set (part 3)

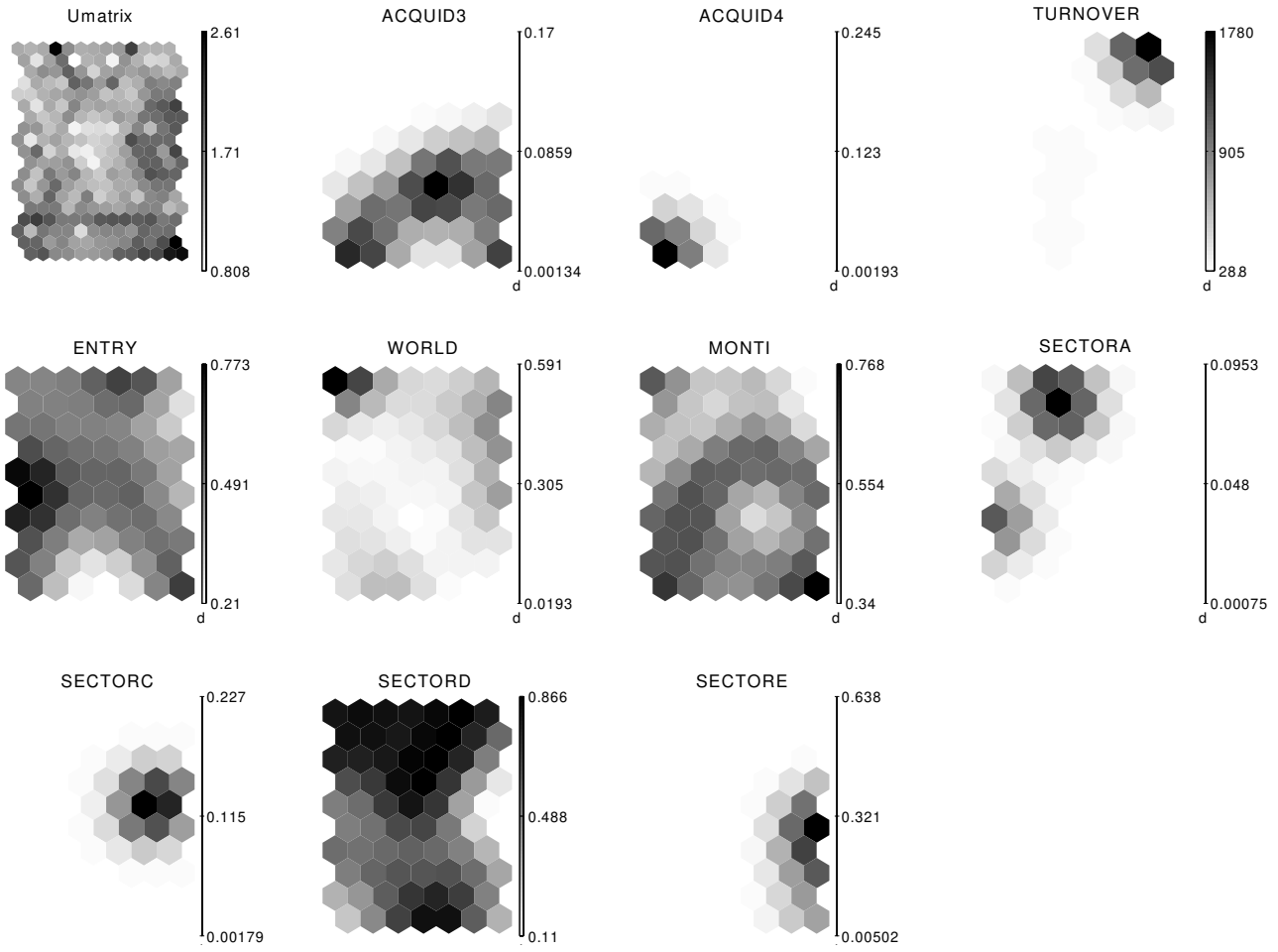

Figure 4: U-matrix and component planes for the EC merger data set (part 4)

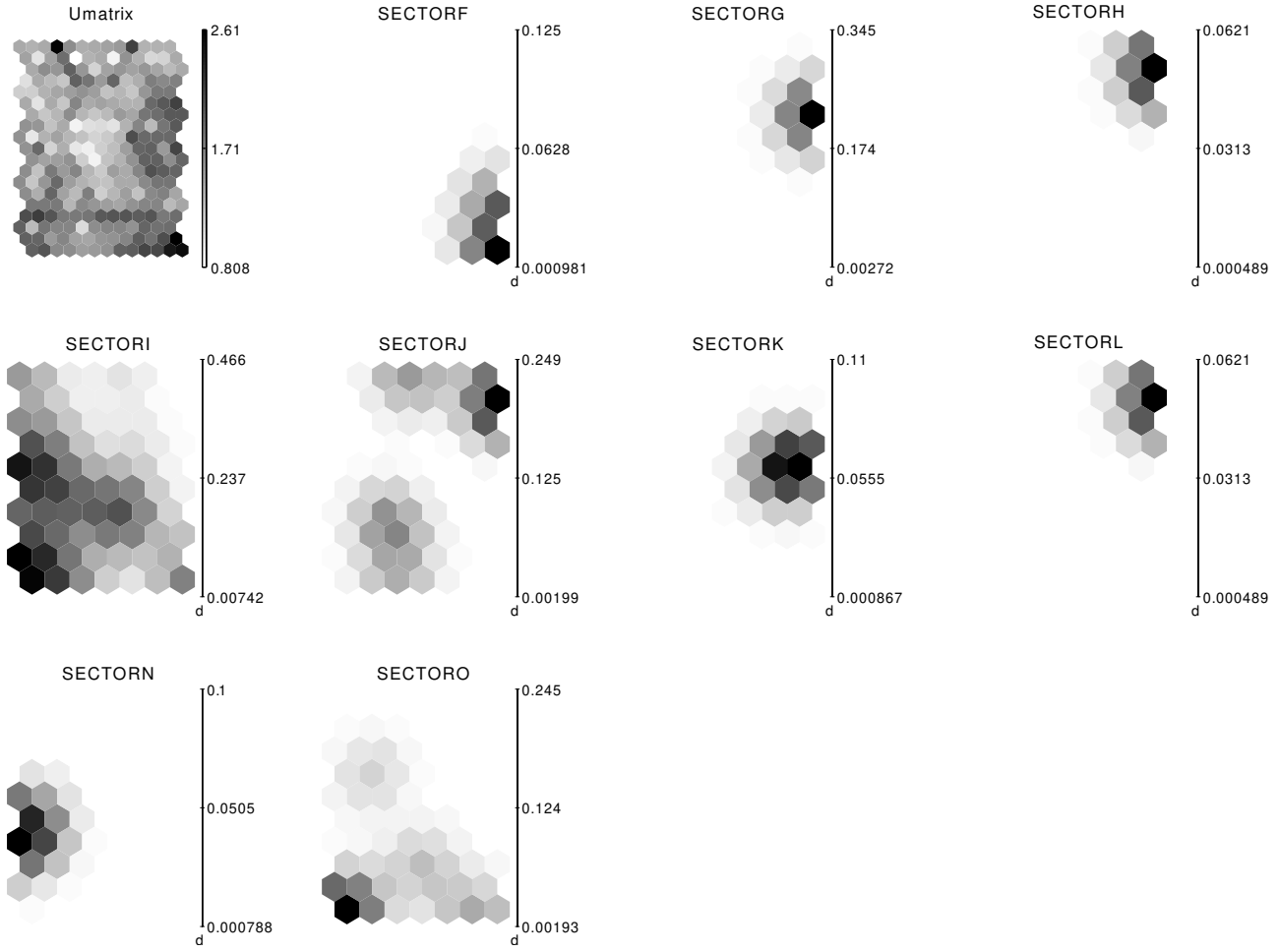

Figure 5: U-matrix and component planes for the EC merger data set (part 5)

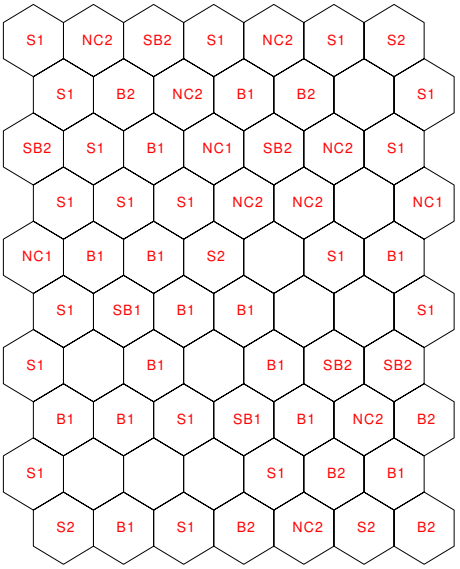

Figure 6: U-matrix for the EC merger data set