DISCUSSION PAPER SERIES

No. 9362

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INDUSTRIAL ORGANIZATION

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ABSTRACT

Anatomy of Cartel Contracts*

We study cartel contracts using data on 18 contract clauses of 109 legal Finnish manufacturing cartels. One third of the clauses relate to raising profits; the others deal with instability through incentive compatibility, cartel organization, or external threats. Cartels use three main approaches to raise profits: Price, market allocation, and specialization. These appear to be substitutes. Choosing one has implications on how cartels deal with instability. Simplifying, we find that large cartels agree on prices, cartels in homogenous goods industries allocate markets, and small cartels avoid competition through specialization.

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1   Introduction

For competition policy to be effective, we need to understand how cartels work. To this end, it is of first order importance to analyze what issues cartels aim to solve and how. Our understanding of cartel organization and operation remains inadequate even though it has improved through both in-depth analyses of individual cartels (Genesove and Mullin 2001, Asker 2010), game-theoretic modeling of cartel contracts observed in some of the recent exposed cartels (Harrington and Skrypacz 2007, 2011) and qualitative analyses of cartel contracts (Harrington 2006, Marshall and Marx 2012). A key factor inhibiting further progress has been lack of data that would allow a quantitative analysis of cartel contracts: that is, how do the contracts look like? Are contracts very similar, or not? What contracting features are used most often? Do some features of contracts appear together often? To address these questions calls for detailed data on the contracts of a large number of cartels, operating preferably in a shared institutional environment. Through archive work, we have generated a data set that enables us to offer such an analysis and to provide an anatomy of cartel contracts, i.e., a list of their stylized facts.

The anatomy of cartel contracts is important in two ways: First, by providing information on how cartels operate, it helps competition authorities to decide where to allocate resources for the detection of cartels, courts and legal scholars to determine the nature of cartel agreements (e.g., Kaplow 2011a,b), and policy-makers to understand the consequences and limits of competition and regulation (Shleifer 2004, 2012). Second, it provides a basis for further development of cartel theory along the lines initiated by Harrington and Skrypacz (2007, 2011) towards models that are in line with stylized facts. Such models are instrumental in pushing further our understanding of how cartels operate, and what types of policies are likely to be effective against them.

Cartels have to solve two fundamental issues: How to raise profits?; and, How to deal with the inherent instability of the cartel agreement? To better understand how these problems are solved and how the cartel contracts look like, we follow a three-step research approach.

In the first step, we pin down the contracting approaches cartels use. To this end, we define a *contract clause* to be a binary choice, indicating whether or not a particular contracting feature is covered. A *cartel contract* can be described by a vector of such clauses, implying that for p clauses, there are $2^p - 1$ distinct types of cartel contracts (i.e., *contract types*). Using this terminology, the received cartel literature (e.g., Stigler 1964, Harrington 2006, Marshall and Marx 2012, chs. 6 and 7) allows us to identify 18 *potential* contract clauses. The different clauses serve different economic purposes and can therefore be classified into four *economic dimensions*: The first economic dimension relates to how the cartel aims to raise profits. One third of the identified contract clauses serve this purpose. The remaining two-thirds of the clauses relate to the instability of cartels and can be grouped into three economic dimensions: How does a cartel seek to solve the incentive compatibility constraint on which economic research has very much concentrated?; How does a cartel organize itself and settle internal disputes?; and, How does a cartel deal with external threats? We expect cartels to only use those contract clauses which address problems they can anticipate to emerge and whose benefits exceed the costs of including them into the contract. Viewed from this perspective, cartels end up economizing on contract completeness and, thereby, follow an incomplete contracting approach (see also Kaplow 2011a, pp. 758-765).

In the second step, we scrutinize how the cartel contracts relate to the size of the cartel in terms of the number of members and to whether the industry produces homogenous or differentiated products. Our motivation to consider the number of cartel members is the attention it has received in the prior literature. In particular, the supergame-

models of collusion suggest that the incentive compatibility constraint is a function of the number of firms in the cartel (industry), with more firms leading to the incentive compatibility condition being harder to satisfy. We focus on product differentiation because almost nothing is known empirically about how this industry feature is associated with the organization and workings of cartels. The available empirical studies (see, e.g., Levenstein and Suslow, 2006, for a review) suggest that collusion mostly occurs in homogenous goods industries, but the small theoretical literature on the effects of product differentiation on collusion is divided on the issue.[1]

In the third step, we provide an exploratory analysis of the complexity and stability of cartel contracts. As far as we are aware, the prior literature is largely silent about them, but they are potentially important in informing policy (e.g., can relatively simple and short contracts sustain collusion?) as well as in furthering the economic theory of cartel contracts (e.g., how often are contracts updated?). A notable study is Taylor (2007), who finds little relation between industry characteristics and use of individual clauses, or length of the contract. The exception is that he reports that cartels in homogenous goods industries use differently some contracting possibilities afforded by the National Industrial Recovery Act.

To implement this three-step research approach, we have collected detailed information on the contracts of 109 Finnish manufacturing cartels. Like the U.S. Sugar Institute analyzed by Genesove and Mullin (2001), these cartels were legal, although the enforceability of the contracts was unclear (see section 7). The cartels covered the whole national market and were registered between 1959 and 1988 by a predecessor of the Finnish Competition Authority. We use information from this Registry to establish which contracting clauses the cartels adopted. The strengths of these data are twofold:

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[1] In addition to analysing how contract design is influenced by the size of the cartels and the degree of product differentiation, we also allow for industry heterogeneity and business cycle effects.

first, the cartels operated in the same institutional environment, removing one potentially large source of heterogeneity (in contracts). Second, unlike illegal cartels, legal cartels do not have to worry about the consequences of explicitly writing down their agreements. We can thus "observe an unobservable", i.e. what illegal cartels would write down, if doing so would not have adverse legal consequences. Indeed, the very fact that cartels are illegal leads to endogenous incompleteness of cartel contracts, because the contracting parties have a strong incentive both to reduce the ability of a legal court to verify the contracted actions and to make unverifiable what is observable. Bar for this difference, legal and illegal cartels have similar incentives to economize on contract completeness in their attempt to coordinate on actions and meet the incentive compatibility constraint.[2]

Our analysis confirms some previous findings in the literature and generates a number of new insights. First of all, we find – consistent with the case studies of Harrington (2006), the literature review of Levenstein and Suslow (2006) and the case studies and theoretical modeling of Harrington and Skrzypacz (2011) – that cartels coordinate on pricing, allocate the market (and/) or coordinate on the positioning in the product space (i.e., who specializes on what). We also find that many, but not all, cartels contract on the incentive compatibility constraint, some aspect of their internal organization as well as on how to deal with external threats. While several papers (e.g. those surveyed in Levenstein and Suslow 2006) report descriptive statistics on what cartels agree on, none, to the best of our knowledge, takes the analysis of cartel contracts further. Our contribution is to do that in the second and third steps of our analysis.

The first step of our research approach looks more closely at the anatomy of the contracts. While essentially all cartels agree on some mechanism to raise joint profits,

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[2] The cartels that we study were legal. We discuss the implications of this for our analysis and interpretation in Section 7.

they differ in how they approach this. By and large, we find three basic *contracting approaches*: The choice to agree on prices, allocate markets, or use some type of non-competition/specialization clause has implications to the rest of the contract. Cartels agreeing on prices do not necessarily use the contract to solve the incentive compatibility problem, but agree on organizational issues. Cartels that use allocation of markets to raise profits make heavier use of contractual clauses designed to affect the incentive compatibility constraint. If cartels use some type of non-competition/specialization clause they are less likely to have clauses for incentive compatibility and for organizational purposes. More generally, it seems that the use of different incentive and organizational clauses go hand in hand: either a cartel uses several (of both) of them, or few. Clauses designed to deal with external threats are the least correlated with the other clauses.

The second step of our research approach shows that the size of the cartel is significantly associated with how the cartel seeks to raise profits: the number of cartel members is positively correlated with agreeing on prices, and negatively correlated with using the non-competition/specialization clause. Cartel size is also positively associated with the use of instability clauses. In contrast to the results on cartel size, we find that cartels in homogenous goods industries are more likely to use market allocation to raise profits. Clauses relating to the incentive compatibility constraint and external threats are also more likely to be used by cartels in homogenous goods industries. Furthermore, several of the correlations between how a cartel raises profits and how it deals with instability are explained by the number of members and homogeneity of products.

Finally, in the third step, we find some evidence that larger cartels use more complex contracts (measured by the number of pages and the number of clauses), as do cartels in industries with product differentiation. While both pricing and market allocation

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cartels seem to have more complex contracts, pricing cartels also change them more often.

The rest of the paper is organized as follows: first, we relate our analysis to the previous economic literature on cartels and contracts in section 2. The institutional environment in which our cartels operated and the 18 contracting clauses on which we have collected information are described in section 3. We then proceed in section 4 to explore how cartels seek to raise profits and how they address the instability of the cartel arrangement. We extend this analysis in section 5, where we look at how the size of the cartel and whether the industry produces homogenous or differentiated goods, correlate with the types of cartel contracts used. In section 6, we analyze the complexity and stability of cartel contracts. Section 7 discusses the extent to which our empirical findings generalize. Using less complete data on 902 Finnish legal cartels from the same era, we show that manufacturing cartels are somewhat different from cartels outside manufacturing: the latter use for example market allocation as a way of increasing profits clearly less often than manufacturing cartels. Section 8 concludes.

2 Related literature

Our paper is at the intersection of two main strands of the economics literature. First, our analysis is related to the economics of cartels, in particular the research that explores their internal workings, organization and specific determinants, such as the number of cartel members and product differentiation. Second, our analysis has connections to the economics of (incomplete) contracts, which for our purposes can be defined to include both empirical work on contracts as well as theoretical analyses of incomplete contracts and relational contracting.

2.1   Internal workings and organization of cartels

An interesting nascent empirical literature studies the internal workings of a cartel.[3]
Genesove and Mullin (2001) study the U.S. sugar cartel by analyzing the documents
from the meetings of the cartel. They show that the cartel resorted to negotiations in the
face of contract violations rather than (directly) going for a punishment (e.g. price war).
The cartel also came up with contractual remedies to the problems that surfaced. Asker
(2010) studies the operations of a New York-based stamp collector's cartel and finds
that despite their very refined operations, the damage they caused was limited. Insight-
ful studies on individual cartels, like the ones mentioned, show that there is heterogenei-
ty in both cartel design and performance that depend on the environment. We seek to
bridge the gap between a deeper understanding of the detailed workings of an individual
cartel and the need to observe stylized facts that pertain to a larger sample of cartels,
both of which are crucial e.g. in designing the right policies.

Another strand of the cartel literature studies samples of cartels. Suslow (2005)
studies the relation between formal cartel contracts and the structure and durability of
cartels using a sample of legal cartels, finding that uncertainty in the operating environ-
ment is inversely related to the stability of cartels. Taylor (2007) analyses the cartel
codes from the National Industrial Recovery Act for cartels registering between 1933
and 1935 in the US and finds that high complexity of cartel codes (contracts) was corre-
lated with slower output growth, indicating that cartels were successful in restraining
output. Levenstein and Suslow (2011) are close to us in having collected information on
comparable contract characteristics of cartels; in their case, of illegal international car-
tels. Like Taylor (2007), they consider them as determinants of an outcome, in their
case of cartel duration. We build on these recent papers and their predecessors (see, e.g.,

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[3] A much larger literature studies the behavior of individual cartels. Prominent examples are Pesendorfer (2000), Porter and Zona (1993, 1999) and Röller and Steen (2006).

Fraas and Greer 1977, Hay and Kelley 1974 and Posner 1970) by bringing new data on legal cartels that share a common institutional environment, to bear on a new aspect of the phenomenon, namely the anatomy of cartel contracts.

Harrington and Skrypacz (2007, 2011), while studying cartel contracts, offer a different approach. They build a theoretical model, derive an equilibrium whose properties match qualitatively the key dimensions of observed cartel agreements in certain markets and show under what conditions an equilibrium with those properties exists. Our aim is to advance this literature by providing a deeper analysis of cartel contracts than has been possible hereto-fore, thereby providing more stylized facts that need to be explained and understood. One could, for example, use our results to first build a model that in equilibrium delivers the type of cartel contract observed in our data under the assumption that there is no competition authority. The environment can thereafter be changed (by, e.g., introducing a competition authority, modelled as a detection probability and an associated fine) to study what type of a cartel agreement arises in the new equilibrium and how cartels adapt (see Marshall and Marx 2012). Viewed from this point, Harrington and Skrypacz model a legal cartel, or tacit collusion, rather than an illegal cartel, as their model does not include a competition authority.

The received theoretical literature suggests that cartel formation and stability should typically be inversely related to the number of market participants and cartel members, but empirically that seems not to always be the case (Levenstein and Suslow, 2006). Even less is known about how product differentiation is associated with the organization and workings of cartels. The empirical literature does suggest that collusion mostly occurs in homogenous goods industries (see e.g., Levenstein and Suslow, 2006), but the theoretical literature addressing the same question portray a more mixed picture. Chang (1991) and Ross (1992) find that differentiation makes collusion easier, while

Raith (1996) and Häckner (1994) find the opposite.[4] Thomadsen and Rhee (2007) show that costs of maintaining collusion increase the difficulty of sustaining collusion more for firms in industries with product differentiation.

2.2   Economic analysis of (incomplete) contracts

Our research has connections to the empirical work on contracts. Lerner and Merges (1998) study the allocation of control rights in alliances between US bio-technology companies and firms sponsoring them financially. Chiappori and Salanie (2000) use French insurance data to test for the existence of asymmetric information in contractual relationships. Ackerberg and Botticini (2002) explore the econometric consequences of endogenous matching in the context of a contracting relationship using historical Italian data on contracts between landlords and tenants. In a paper that is close in spirit to ours, Kaplan and Strömberg (2003) use venture capital contracts in the US to investigate how well their dimensions map to the predictions of financial contracting theory. A difference between our paper and theirs is that while they could confront their empirical regularities with a rich theoretical literature on financial contracting, the existing theoretical literature on cartel contracts is rather thin. As a substitute, the existing theoretical literature on cartel performance is rich.

Illegal cartels that rely on self-enforcing relational contracts have to agree explicitly on at least something, as otherwise collusion would be tacit (see e.g. Kaplow 2011a,b). That is, illegal cartels have to explicitly outline which contract dimensions their formal collusive contract includes and face the risk of penalties and damages. Alternatively, a cartel needs to just informally agree on how a cartel contract would look like, if it was actually written. In either case, the theory of endogenously incomplete contracts suggests that like legal cartels, illegal cartels are likely to make use of (only)

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[4] Deneckere (1983), Majerus (1988), Rotschild (1992), Ross (1992), Häckner (1994), Raith (1996), Lambertini and Schultz (2003) and Schultz (2005) study closely related models and questions.

those contract dimensions whose benefits exceed the costs of including them into the (actual or virtual) contract. The benefits are related to the increased collusive profits and greater stability (Harrington and Skrypacz 2007, 2011), whereas the costs can be cognitive (Tirole 2009), informational (Spier 1992) or plain ink costs (e.g. Dye 1985, Anderlini and Felli 1994, Battigalli and Maggi 2002, 2008), or some combination of the three. The theory also predicts that if cartel contracts fall into the category of incomplete contracts, cartels should mostly agree on control rights, discretion and decision-making rules (Bolton and Dewatripont 2004, pp. 37).[5]

3 The institutional environment and data

This section describes both the institutional environment in which our cartels operated, our sources of data, and the 18 contracting clauses on which our analysis builds.

3.1 The institutional environment

The development of Finnish competition policy after the Second World War follows closely developments in other European countries, and Sweden in particular. There was no competition policy before the war (see Fellman 2008). After the war, a committee was set up in 1948 to draft a framework for competition legislation. This work resulted in the first cartel law which took effect in 1958. The central idea was to collect information on rather than deter collusive activities. For this purpose, a (predecessor of the) Finnish competition authority (CA) was set up and given the task to register cartels.

The CA was active, sending out thousands of inquiries and registering several hundred cartels in the first three years of its operation. Registration in the Registry was contingent on the CA contacting the cartel. This changed in 1964 when the law was revised. Now cartels with a formal organization (such as an association) had to register.

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[5] The theory that treats the completeness of contracts as endogenous has not yet settled on key determinants; see, e.g., Bolton and Dewatripont (2004) for a textbook treatment and Tirole (2009) and Kvaløy and Olsen (2009) for some more recent advances.

In 1973 the registration requirements were again somewhat tightened. In the 1980s Finland finally edged towards a modern competition law, as the work of a committee established in 1985 resulted in a new law taking effect in 1988. This cumulative process of law changes that progressively made the environment less permissive now made void possible sanctions in cartel agreements. A primary motivation for this change was the only known law suit based on a cartel contract from early 1980s that had led to damages being awarded.[6] Cartels became illegal in the beginning of 1993. These changes mean that there was - similar to the case of the U.S. Sugar Institute (Genesove and Mullin 2001, pp. 385) - ex ante uncertainty as to the enforceability of these contracts in court.

Our understanding of the past regime, based on written accounts and discussions with people familiar with the era, is that the costs of registering were minor. There were costs of not registering; in particular, not registering could have made enforcement of the contract more difficult, though taking contract breaches to the court was very rare. It also seems that there were other benefits tied with registering. The former and current Director Generals of the Finnish CA (Purasjoki and Jokinen, 2001) sum up the environment concerning those collusive practices that were legal: "*Time was such that there seemed no need to intervene even in clear-cut cases, especially if they had been registered. Registration had been transformed into a sign of acceptability of the [cartel] agreement, at least for the parties involved [in the cartel]*".

3.2   Data sources

Our data consist of information on cartel contracts, industrial statistics and macroeconomic variables. They come from three sources.

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[6] We have interviewed people with a long working history in the Finnish Competition Authority. They could recall only one case from the early 1980s. According to the Director General of the Finnish Competition Authority, Juhani Jokinen (private exchange), this case lead to the law change in 1988 making sanctions in cartel contracts void.

All the data on cartel contracts is based on archive work in the Registry. For each registered cartel, the Registry established a folder, and gave an identification number. The folder contains all the correspondence between the Registry and the cartel. The Registry also always asked for the actual cartel contract. Once a cartel was registered, basic information on it was published in the Official Journal of the Finnish government. Thus, the Registry made cartels public. All our data on the contracts and cartels are based on the information available in the Registry.

The Registry contains in total some 900 cartels. As archive work is time consuming and expensive, we could not include all of them in our sample. We decided to concentrate on nationwide manufacturing cartels, and chose to include the first cartel(s) in a given (3-digit) industry. This resulted in us going through the folders of 109 cartels in a very detailed manner.

We used a semi-structured approach to collect information on 18 potential contract clauses.[7] We discuss the 18 clauses and other information we collected shortly. In addition to this information on contract clauses we collected information on the length (in pages) of the contract, the number of contract changes and the number of members in the cartel.

To this data we have matched 4-digit industry statistics from Statistics Finland, measured in the year prior to the registration of a cartel. To measure product differentiation we have constructed an index (*Homogenous_d*) that indicates whether an industry primarily produces homogenous goods (=1) or not (=0). We followed the existing literature (Rauch 1999, Foster, Haltiwanger, Syverson 2008) and studied the characterization of each 4-digit industry, and the description of the goods produced by the cartel devised by the Registry to determine whether the cartel was producing homogenous goods or

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[7] After initial discussions on how to interpret contracts, we first randomly chose eight cartels and had four researchers go through each of them independently. We then checked for any differences in interpretation, and decided on a common approach. We thereafter followed a written protocol with the 109 cartel contracts.

not.[8] Finally, our source for macroeconomic variables is the database of the Research Institute of the Finnish Economy (ETLA). We describe the industry- and macrovariables in greater detail in section 5.

3.3 Cartel contracts and contract clauses

A *cartel contract* can be described by a vector of contract clauses. Each clause is binary, describing whether a particular contractual feature is or is not included in the contract. We collected information on 18 potential contract clauses, basing our work on Harrington (2006) and more broadly on the economics of cartels (e.g., Stigler 1964, Levenstein and Suslow 2006, Marshall and Marx 2012, chs. 6 and 7). Excluding the possibility of not choosing any clause (as this would result in there not being a contract), each cartel in our data uses one of the $2^{18} - 1$ (= 262 143) possible types of cartel contracts (i.e., *contract types*).

The different clauses can be classified in four *economic dimensions*: The first economic dimension refers to how the cartel affects the market outcome – raises profits. One third (6) of the contract clauses fall in this dimension. The remaining two thirds relate to cartel instability. To systematically analyze these latter 12 clauses we group them further into to three economic dimensions. This leaves us with four economic dimensions: i) market power attributes (MPA), which describe what a cartel agrees upon to increases its profits, and three instability dimensions; ii) the incentive compatibility constraint (ICC), which is about the different contractual ways of dealing with incentive compatibility; iii) the internal cartel organization (ICO) of the cartel, and iv) the external cartel contract (ECC), which is about dealing with external threats.

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[8] To give a couple of examples, the cartel producing cardboard was classified as a homogenous goods cartel, while the cartel producing dairy products was classified as producing differentiated goods. We sought to be conservative in classifying an industry (cartel) to produce homogenous goods. An inspection of the industries and the classification suggests that many of the industries we classified as producing homogenous goods are upstream industries selling to other firms rather than directly to consumers.

The upper part (Panel A) of Table 1 provides an overview on the 18 contract clauses and the economic dimensions to which they match. We now give brief descriptions of each of them.

[TABLE 1 HERE]

MPA – Market Power Attributes

Six of the 18 contract clauses have to do with MPA. This category includes the following measures: *Pricing*, *Market allocation*, *Efficiency*, *Technology*, *Non-price clauses* and *Non-competition/specialization*. The first one, *Pricing*, takes the value one if the contract mentions agreements on prices, pricing rules, discount rules and/or rules of delivery and payment.[9] *Market allocation* takes the value one if the contract specifies sales quotas or market shares, the cartel uses exclusive territories, or the contract allocates customers among the members. It takes the value one also if the contract stipulates that the members follow a "home-market principle", i.e., they refrain from entering each other's (geographic) "home" markets.[10] *Efficiency* takes on the value one if the contract has a section stipulating that sales and/or production should be allocated according to efficiency. As an example, some contracts stipulate that the member whose facility is closest to a given customer should deliver the goods. *Technology* in turn takes value one in the case the contract has a clause about sharing of technological knowledge such as patents or blueprints. *Non-price clauses* is given the value one if the contract mentions

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[9] *Pricing* takes the value one if the cartel agrees on any of the following: Price, pricing rule, discounts, terms of delivery. Of the 63 contracts that use *Pricing*, 78% agree on price, 10% specify a pricing rule, 50% rules on discounts, and 48% terms of delivery. These clauses turn out to be mostly substitutes: All other correlations but that between discount rules and terms of delivery (0.33, p-value 0.01) are negative. Only two however are statistically significant. Price and pricing rule have a correlation of -0.61 (p-value 0.00) and discounts and pricing rule a correlation of -0.21 (0.10).

[10] Sales quotas are used by 66% of the 29 cartels using *Market allocation*, territories by 28% and the home-market principle by 10%. With only 29 cartels using *Market allocation*, an analysis of correlations is at best suggestive: Keeping that in mind we find that all correlations are negative and large in absolute value: -0.21 (the home-market principle and territories), -0.47 (sales quotas and the home market principle) and -0.69 (sales quotas and territories), and all but that of the home-market principle and territories statistically significant.

any non-price restrictions.[11] These include things like add-ons, bundling, and quality. Finally, *Non-competition/specialization* takes the value one if the contract stipulates that the members are to specialize in one way or the other, as well as if the cartel members simply agree to "not compete" in a given market.[12]

The difference between a cartel having the *Non-competition* clause and having the *Market allocation* clause is that the former includes the parties agreeing e.g. on partitioning the production of goods with one of the parties agreeing to cease production of certain parts of the good in question, whereas the latter has no direct impact on production, only on distribution. The cartels using *Non-competition/specialization* are not the standard textbook cartel because, after implementation, often only one of the parties remains active. We feel that it is justified to regard these as cartels first, because the transaction ensures that joint profits can be maximized and second, as the contracts almost invariably include non-competition clauses where the party ceasing production is not allowed to re-enter, nor to sell its knowledge to third parties.

ICC – Incentive Compatibility Constraint

We looked for four ways of dealing with ICC. *Monitoring* takes value one if the contract has a clause on how the members monitor each other. As an example, the plywood cartel had a clause whereby "all information on sales, deliveries and production must be given to the Association twice a month; twice a year a certified auditor's statement of the correctness of previous notifications is required". *Enforcement* takes value one if the contract stipulates how to handle situations where a member has deviated. Such instances include the mention of price wars of some type, retaliation, and compensations. An example is the clause used by the glass cartel: "The delegation has the right to order

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[11] We also collected qualitative evidence information on the MPA contract clause *Non-price*. We didn't find much, and the most frequent were different ways of minimizing product differentiation. For example, cartels could agree on standardizing products, or packages.

[12]*Non-competition/specialization* was used by 42 (39% of) cartels. The correlation between the clauses on non-competition and specialization is negative (-0.23) but statistically insignificant (p-value 0.14).

production reductions or temporary closing of a plant. Compensation must then be paid". The variable *Expel* takes the value one if the cartel has rules on how to expel a member if rules are broken. Similarly, *Fine* takes the value one if the contract includes a clause on monetary fines for a company that violates the contract. Fines were usually either a percentage of some measurable activity like sales; sometimes a minimum monetary fine was defined.

ICO – Internal Cartel Organization

The third economic dimension, ICO, is captured by five measures. *Meeting* takes the value one if the contract stipulates whether, and if so, how often, the members are to meet. *Dispute-resolution* in turn takes the value one if the contract specifies a way in which disputes among members are to be resolved. There were two primary ways in which disputes resolution was specified in the contracts: either an internal mechanism, or an external mechanism (court, arbitration).[13] *Structure* takes the value one if the cartel has a formal structure such as an association or a limited liability company to organize itself. *Vote* takes the value one if a voting procedure is specified in the contract.[14] Finally, *Sales* takes the value one if the cartel has formed either a trade or a sales association.

ECC – External Cartel Contract

We searched for three ECC characteristics: *New members* takes the value one if the contract specifies a policy on how to accept new members. *Non-cartel supply* indicates whether or not the cartel members have a clause on how to deal with supply from non-

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[13] One solution used by cartels was to use the arbitration provided by the Finnish Chamber of Commerce, used e.g. by the match makers cartel after their reorganization. The Chamber unfortunately keeps the (as such confidential) arbitration documents for only ten years, and thus their archive would not shed light on whether cartel members really resorted to arbitration.

[14] Those cartels that use the ICO clause *Vote* often specify the voting rules: Voting power is distributed according to (sales) quotas or sales (billing), using the 1-share-1-vote-rule, as relative to wages paid, or as a function of the size of the members. As an example, the cardboard cartel used the following voting rule: "Voting power is based on production (volume)".

member rivals. Finally, *Entry* takes value one if the contract stipulates how to react to entrants into the industry.

In the rest of the paper, we use these four economic dimensions, $d \in \{$MPA, ICC, ICO, ECC$\}$ to organize the contracts and to sketch their anatomy.

3.4 Descriptive statistics

We present the first descriptive statistics in the lower part (Panel B) of Table 1 (see also Appendix 1). The panel reports figures for the extensive margin, i.e., how prevalent it is for a given cartel to have at least one clause covering economic dimension d in its contract. Almost all cartels (105 out of 109, or 96%) include at least one contractual measure in the MPA dimension, i.e. on how to increase profits.[15] This prevalence is not very surprising given the objective of cartels: they must agree on at least one way to increase the joint profits of their members.

There is much more variation in the ICC, ICO and ECC dimensions. About half (52%) of cartels have one or more contractual clauses for ICC, which are designed to deal with incentive compatibility. This is a relatively low percentage relative to the amount of attention that the economic literature has devoted to the incentive compatibility of cartel agreements. A high percentage (85%) of cartels has at least one contract clause designed to detail cartel organization (i.e., in the ICO dimension). Finally, some three quarters (73%) of cartels went through the trouble of taking into account external threats (ECC) in their contract.

The lower panel of Table 1 also reports descriptive statistics on the intensive margin, which here refers to the fraction of all possible contract clauses that cartels use in a given economic dimension of the contract, conditional on usage. The first row tells us

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[15] Of the four who do not have an MPA clause, two are in publishing, one in pharmaceuticals, and the last in jewelry/goldsmith products. For the pharmaceuticals cartel, agreeing on how to raise profits was probably unnecessary given that the industry was heavily regulated (including prices), although one could think that they could have used a *Non-competition/specialization* clause for example.

that those cartels that include at least one MPA-related clause in their contract use on average 30% (i.e., roughly two out of the six possible) clauses to specify how profits are to be increased. The fraction of clauses in the ICC dimension, conditional on usage, is 40% out of four possible clauses. Those cartels that contractually specify something about how the cartel is organized use roughly half of the available five measures. Finally, we find that cartels use, on average, less than half of the three contract clauses available to deal with external threats.

Table 1 is consistent with cartels economizing on contracting and adopting an incomplete contracting approach. Cartels appear to use the four economic dimensions selectively. The intensity of usage is not particularly high in any of the four economic dimensions, suggesting that a few contract clauses in a given economic dimension are deemed enough.[16]

[TABLE 2 HERE]

To describe the data further and to shed light on the relative importance of the four economic dimensions, Table 2 takes a *contract design* to be a four-tuple {MPA, ICC, ICO, ECC}, where each element takes the value 1 if the contract of a cartel has at least one contract clause that belongs to the corresponding economic dimension. This means that for the purposes of Table 2, we view the cartels as having the choice of choosing any of the 15 possible combinations of economic dimensions available to them.[17] As the first column of the table shows, only ten basic contract designs can be

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[16] This does not mean, say, that the 48% of cartels not using an ICC clause would not have taken care of the incentive compatibility of their cartel arrangement. It may merely mean that they found the costs of using an explicit contractual clause for the incentive compatibility higher than the benefits such a clause would bring. It is also possible that other dimensions of the contract made having an explicit incentive compatibility clause unnecessary. The cement cartel in the data may serve as an example: the two firms agreed on geographical market allocation. Given the locations of their production facilities, this may have made the use of explicit incentive compatibility clauses unnecessary as (apart from maybe at the border of their allocated regions), the only way to cheat on the contract on a large scale would be to open a production facility in the other firm's territory. This would be easy to verify.

[17] There are at most $2^4 - 1 = 15$ distinct contract designs that we *could* observe. The space of the contract designs is conditional on the number of underlying metrics and is here defined by the four economic dimensions.

identified from our data. The next columns show that 39% (42 out of 109) cartels use the most popular contract design, which covers each of the four economic dimensions. The second most popular one is used by 27% (29 out of 109) cartels and it covers all other dimensions *but* the ICC dimension emphasized in economic research. The three most popular contract designs are all fairly comprehensive, covering at least three of the four economic dimensions. They are chosen by 73% (80 out of 109) of the cartels, which means that the distribution of contract designs is skewed.

The last columns of Table 2 show the intensive margins of the contract designs. On the one hand, we find surprisingly little variation over the various designs. On the other hand, we find – as we already inferred from Table 1 – that intensity of usage is not particularly high in any of the four economic dimensions, suggesting that a few contractual clauses in a given economic dimension are deemed enough.

In sum, the descriptive statistics of Table 1 and 2 show that almost all contracts have at least one profit (MPA) clause, making it – unsurprisingly – a fundamental building block of cartel contracts. However, there is a lot of concentration and cartels use the remaining three economic dimensions – ICC, ICO and ECO – quite selectively.

4   Analysis of contracting approaches

The descriptive statistics on the basic features of the contract data suggest that we should take a closer look at the MPA, i.e., how cartels try to raise profits and, in particular, whether this choice has implications to the rest of the contract. This section therefore aims at identifying *contracting approaches* of cartels, i.e., sets of cartel contracts that are comparable in how they are designed to raise profits and deal with instability. This entails looking for contract clauses that consistently appear together both within

and across the four economic dimensions. When such patterns are present, they are indicative of gross complementarities (or gross substitutability).[18]

4.1   How do cartels raise profits?

We start by taking a look at how prevalent the various MPA clauses are (Table 3) and at their unconditional correlations (Table 4).

Table 3 shows that *Pricing*, *Market allocation*, *Non-competition/specialization* and *Technology* are more common than *Efficiency* and *Non-price clauses* in our sample. Table 4 shows, in turn, that out of these more common clauses, *Pricing* is negatively (and mostly significantly) correlated with the other, more common MPA clauses. This is suggestive of *Pricing* being a gross substitute for the other MPA clauses. *Market allocation* is not correlated with the other more common clauses. Finally, *Non-competition/specialization* and *Technology* are positively correlated.[19]

[TABLES 3 AND 4 HERE]

These patterns suggest the existence of three MPA-driven contracting approaches. The three contracting approaches are built around the most prevalent MPA clauses, with their cores referring to *Pricing* (often together with *Non-price*), *Market allocation* and the amalgam of *Non-competition/specialization* and *Technology,* which are highly correlated with each other (we henceforth refer to this amalgam as *Non-Comp-Tech*). This view is strengthened when one compares the use of *Pricing*, *Market allocation* and *Non-competition/specialization* to the use of the other three MPA clauses. Of the 105

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[18] We use terms "gross complementarities" and "gross substitutes" to make it clear that our data are not rich enough for us to test explicitly for the presence of complementarities among the contract clauses. The clustering patterns that we find may therefore mirror real complementarities of contract clauses, affiliated but unobserved net returns to their adoption and/or higher order complementarities (i.e., chain reactions due to interaction of pairs of clauses when there are more than two endogenously chosen clauses in the contract); see, e.g., Arora (1996), Athey and Stern (1998) and Kretschmer, Miravete and Pernias (2012) for discussion.

[19] Of the 63 cartels using *Pricing*, 22% use also *Market allocation* and 10% *Non-competition/specialization*; of the 29 cartels using Market allocation, 48% use *Pricing* and 41% *Non-competition/specialization*; and of the 42 cartels using *Non-competition/specialization*, 14% use *Pricing* and 29% *Market Allocation*.

cartels that use at least one MPA clause, 99% (=104/105) use at least one of *Pricing*, *Market allocation* and *Non-competition/specialization*, whereas only 47% (= 49/105) use at least one of the remaining three.

Seen this way, we find that cartels use three main approaches to raise joint profits, and that these appear to be gross substitutes. These patterns can also be found once we condition on observable cartel characteristics. Perhaps as importantly, we find that choosing any one of the three most prevalent MPA clauses has implications to the rest of the contract.

4.2 How do cartels deal with instability?

Table 5 explores whether the various instability clauses are systematically associated with the MPA clauses. We display the unconditional correlations of the various MPA clauses both with the three economic dimensions (ICC, ICO and ECC) and also with the individual clauses of which they consist.

Focusing on the extensive margin w.r.t. ICC, ICO and ECC, it seems that the three main MPA contract clauses each have a particular correlation structure with the rest of the contract. *Pricing* and *Market allocation* are positively correlated with the use of ICC and ICO, and negatively, or not at all, with the use of ECC. In contrast, *Non-Comp-Tech* is negatively correlated with the use of ICC and ICO but positively with the use of ECC. The unconditional correlations of the MPA clauses with the individual ICO, ICC and ECC clauses reveal more heterogeneity, but are broadly consistent with these patterns.[20] These findings imply that choosing one of the three MPA clauses has implications to the rest of the contract and suggest three basic contracting approaches.

[TABLE 5 HERE]

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[20] To be more precise, out of the individual contract clauses, only *Dispute-resolution* in ICO and *Member* in ECC appear not to share the correlation structure that the other clauses have with the main MPA clauses.

To check that the above observations are not an artifact of how we have approached the data, we also analyze the structure of the 18 contract clauses without first assigning them into the four economic dimensions. In our data, only 80 unique contract types can be observed in the larger 18-dimensional contracting space. This confirms that only a small fraction of all potential contract types is used. Moreover, the most popular contract type in the space of 18 contract clauses is used by 8% (9/109) cartels. In line with our earlier analysis along the four economic dimensions, the most popular contract type spans all four dimensions. The second most popular contract type spans three of the four economic dimensions and is used by 5% (5/109) of the cartels. Again, in line with our previous results, but surprisingly given the existing literature, it contains no ICC clauses. Defining contracts to be close when they differ in at most the use of two clauses, we find that 31% (34/109) of the cartels use one of the two most popular contracts, or contracts close to them.[21]

We have also analyzed the clustering of the 18 contract clauses graphically and by exploring how many contracts differ from the most popular contracts by one or two clauses (see Appendix 2). These analyses support the view that there are three main contracting approaches that cluster around the most prevalent MPA clauses.

4.3   Summary of the contracting approaches

We find that that all cartels agree on some mechanism to raise joint profits, but use different approaches. The most commonly used MPA-clauses appear to be gross substitutes, i.e., they are not used consistently together. Moreover, choosing any one of them has implications to the rest of the contract: *Pricing* and *Market allocation* are positively

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[21] The most complicated contract uses 78% (i.e., 14 out of 18) of the contract clauses. This cartel was a joint sales organization of plastics manufacturers. The four clauses this cartel did not use are *Non-price*, *Monitoring*, *Meeting* and *Entry*. The six cartels with only one clause are: a cement cartel that used *Market allocation* (geographic territories); a cartel on manufacturing of bicycle parts (*Non-competition/specialization*); a cartel on steam boiler production (*Pricing*); a cartel on manufacturing of metallic construction items (*Pricing*); a cartel on manufacturing of leather bags and other leather apparel (*Pricing*); and a cartel on manufacturing of made-up textile goods except wearing apparel (*Pricing*). On the other hand, the simplest contracts use only one of the MPA clauses.

correlated with ICC and ICO, and *Non-Comp-Tech* appears to have gross complementarities with ECC. This correlation structure suggests that there are three main contracting approaches that cluster around the most prevalent MPA clauses.

5   Contract heterogeneity

In this section we study how observable cartel- and industry characteristics are related to the cartel contracts and to their correlation structure. We do it in two ways. First, we consider the observable determinants of the 18 contractual clauses. Second, we redo the correlation analysis of the previous section to check the extent to which the unconditional correlation structure between the various contract clauses can be explained away by the observables.

5.1   Observable heterogeneity in cartel contracts and contracting approaches

We report here results from Probit models where the dependent variables are the 18 contractual clauses of which the four economic dimensions and consist. These estimations allow us to directly study how the use of a certain contract clause is associated with observable industry and cartel characteristics.[22]

The key explanatory variables are the number of cartel members and the indicator that measures product differentiation (*Homogenous_d*) in the industry. The median number of cartel members in the sample is 4 (see Appendix 1). About 44% of the cartels operate in an industry that produces homogenous goods.

We also control for other industry characteristics and the state of the macroeconomy at the time of writing the contract. The industry characteristics are the gross value of production (GVP), the (raw) material cost divided by GVP, the ratio of blue-collar

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[22] We estimate individual probits instead of following the standard discrete choice approach (e.g. McFadden and Ruud 2000) of treating the different potential cartel agreements as different "products" in a choice set, from which each cartel chooses the one that maximizes its utility. The main reason is the large size of the choice set relative to the number of cartels we observe.

hours to GVP, and the number of plants in the industry, all measured at the 4-digit industry classification of the cartel. All industry variables are measured one year prior to the cartel registering. We include the following macro variables: HP-filtered GDP (with smoothing index of 100) and the absolute values of the positive and negative shocks to GDP. By using these three variables we can separately control for the level of GDP and positive and negative shocks to GDP. We also include the year of registration to capture unobserved time-specific determinants of cartel contracts.[23]

Tables 6 and 7 present the average marginal effects for cartel size and the homogenous industry dummy for the MPA clauses and the ICC, ICO, EEC clauses, respectively (for the marginal effects of the economic- and industry variables, see Appendix 3).

[TABLES 6 and 7 HERE]

Cartel size

Cartel size obtains a statistically significant coefficient in most cases. It is, however, differently associated with the three most commonly used MPA clauses: *Market allocation* is uncorrelated, *Pricing* positively correlated and *Non-Comp-Tech* negatively associated with cartel size. This suggests that the way in which a cartel decides to increase profits and, by implication, its chosen contracting approach, is related to the number of cartel members.

Turning to the instability clauses, we find (from the last three columns of Table 6) that the usage of the three economic dimensions (ICC, ICO, ECC) are significantly and positively affected by cartel size. As Table 7 shows, the picture is somewhat richer at the level of individual clauses.[24]

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[23] The estimations use a sample of 107 cartels, as we lack information on the number of members for two (pricing) cartels.

[24] To be more concrete, we find the following: The marginal effects of cartel size for clauses on internal cartel organization (ICO) are either significantly positive (3), positive (1) or very close to zero (1), clearly suggesting that cartel size is positively correlated with the use of organizational ICO clauses. For ICC and ECC the disaggregated effects are of both signs and thus more difficult to interpret.

Product differentiation

The homogenous goods-dummy is significantly positively associated with the use of two of the six MPA clauses (Table 6): *Market allocation* is more likely and the *Efficiency* clause less likely to be used by cartels in homogenous goods industries. In the raw data, 77% of the *Market allocation* cartels are found in homogenous goods industries, but the percentage is only 33% for the cartels choosing *Efficiency* (see Appenix 1).

The homogenous goods-dummy is also positively associated with the extensive margin of ICC, ICO and ECC (Table 6). However, only the last (ECC) is statistically significant. This nevertheless suggests marginally increased usage in homogenous industries. Echoing this, we find from Table 7 three statistically significant positive marginal effects and no negative and significant ones: one of the positive and significant marginal effects is for an ECC clause (*Entry*), while the other two are for ICC clauses (*Monitoring, Enforcement*).

5.2   Conditional correlations

Here we redo the correlation analysis of the previous section (i.e., Tables 4 and 5) by studying the matrix of correlation coefficients between the *generalized residuals* of the estimated Probit models. This conditional correlation analysis allows us to check the extent to which the unconditional correlation structure between the various contract clauses is explained by the observables.

The correlations of the generalized residuals are displayed in Table 8. We have two main findings. First, the correlation structure across the MPA clauses stays more or less the same. Second, the relations between the MPA clauses and the instability clauses change. The unconditional correlations (Table 5) suggested a pattern across each of the three most commonly used MPA clauses and the instability clauses. Now this pattern mostl disappears or gets weaker: The correlation between MPA clauses and ECC and ICC disappears, and the relationship between the MPA clauses and ICO are weakened,

but not by as much.[25] In particular, after conditioning, *Pricing* is no longer correlated with ICC, ICO and ECC. *Non-competition/specialization* is still negatively correlated with ICO, but is not correlated with ICC and ECC anymore. It is important to note that when we *exclude* the number of members and *Homogenous_d* from the Probit specifications, the correlations between the generalized residuals are again close to the unconditional correlations.

[TABLE 8 HERE]

5.3   Summary of the heterogeneity in cartel contracts

We find that the size of the cartel is associated with the choice of how to raise profits, being positively correlated with the use of *Pricing*, negatively with the use of *Non-Comp-Tech*, and uncorrelated with *Market Allocation. Market Allocation* is positively correlated with the cartel operating in a homogenous goods industry. Cartel size is mostly positively associated with the use of instability clauses in ICC, ICO and ECC.

The relationship between the three most commonly used MPA clauses is robust to cartel-/industry heterogeneity and business cycle conditions. However, the relations between the three most commonly used MPA clauses and the instability clauses get weaker. It is thus the observables, in particular the number of members and the homogenous goods -dummy, that drive many of the unconditional correlations.

Although our results are correlations instead of causal results, one may want to speculate about the mechanisms bringing them about. The positive correlation between *Pricing* and cartel size may be explained by the fact that large cartels would find it harder to e.g. allocate markets than agree on prices; similarly, coming up with ways of avoiding competition through specialization may become increasingly hard as the num-

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[25] Looking at the relationship between MPA and the instability clauses (individual clauses and extensive margins) we find for ECC that 13 of the 24 unconditional correlation coefficients were significant, now only seven are significant. For ICC were the number of significant correlations is reduced from 13 to five out of 30. Finally, while 18 of 36 the unconditional correlations between MPA and ICO were significant, the number is now reduced to 14.

ber of members increases. A possible reason for the positive correlation between *Market Allocation* and the homogenous goods dummy could be that it is easier to divide markets e.g. geographically when the product is homogenous. Another explanation for the correlation could be that many homogenous goods industries sell to other firms instead of consumers. In such markets prices aren't necessarily observed, making it harder to monitor coordination on prices (than, e.g., an agreement on spatial market allocation).

6 Complexity and stability of contracts

The above results already speak to the variation in the complexity of contracts. In this section we explore further the complexity and stability of cartel contracts. We do so by regressing indicators of complexity and stability on a set of cartel and industry variables and by summarizing three case studies that we have conducted.

6.1 Regression analysis

We employ two measures of "complexity": the number of clauses used by the cartel (mean = 5.60) and, following Taylor (2007), the length of the contract measured in pages (mean = 3.32). Our measure of contract stability is the number of times the cartel registered a change of contract with the Registry (mean = 1, max=14). This measure is related to contract complexity and mirrors how stable the contracts were from a contracting point of view, i.e., how the characteristics of the cartel, the initial contract, and the environment at the time the initial contract was registered affect the number of times the contract was changed.

Table 9 presents eight Poisson regressions that shed light on the complexity of cartel contracts. There are three dependent variables: the number of clauses in a contract, the number of pages of the contract and the number of contract changes (see Appendix 1 for a distribution of the number clauses and contract changes). The explanatory variables include the number of members and the homogenous goods-dummy, as well as the same controls as used in the Probit models earlier. In addition to these, we in-

28

clude the MPA clause indicators and the extensive margin for the instability clauses (ICC, ICO and ECC) in some of our regressions.

[TABLE 9 HERE]

Three main findings can be made from Table 9. First, the number of clauses is positively correlated with the number of members, suggesting that large cartels have more comprehensive and complex contracts (columns 1 and 2). The number of pages is also positively correlated with the number of members, but this coefficient becomes insignificant when we include controls (columns 3, 4 and 5). A potential explanation for the positive association is that an increase in the number of members raises the cost of relying on informal agreements as opposed to relying on formal contract clauses. Second, the degree of product differentiation is not correlated with the number of clauses, but cartels in homogenous goods industries have shorter contracts. These findings could be explained by homogenous goods industries having less need to contract on product characteristics and quality. Third, as also the raw data suggest (see Appendix 1), we find that cartels using *Pricing* and *Market Allocation* contracts write longer contracts. Cartels using ICC and ICO clauses also have longer contracts.

Turning then to columns 6, 7 and 8 of Table 9, we find that the number of contract changes seems initially positively correlated with both cartel size and the homogenous goods-dummy. These results however disappear when we include controls. *Pricing* cartels have significantly more contract changes and *Non-Comp-Tech* cartels fewer contract changes. The first result is not entirely surprising, as some of the contract changes are about changes of prices. *Market Allocation* cartels are no different from the other MPA contract types.

6.2   Case studies

We have conducted case studies of one *Pricing* cartel (the match producers cartel), one *Market allocation* cartel (the cement cartel), and one *Non-comp-Tech* cartel (the ply-

wood box cartel). Our choice rule was to choose the earliest registered cartel in a homogenous goods industry that uses only one of the three aforementioned main MPA clauses. As we describe in more detail in Appendix 4, all these cartels used relatively short and simple contracts. This is consistent with the above results on contract complexity, as all three have a small number of members and are in homogenous goods industries.

7   Discussion

In this section, we discuss briefly three issues: first, do our results generalize to beyond the sample of 109 manufacturing industries and cartels? Second, how do our results compare to what is known about cartel contracting in other institutional environments and countries? Third, we discuss the relationship between legal and illegal cartel contracts.

Our analysis has focused on the 109 nationwide manufacturing cartels that were the first registered cartels in a given (3-digit) industry. To check how representative this sample is, we use more limited information from a larger sample of 902 legal cartels from the same era. This sample covers both manufacturing and non-manufacturing industries and contains cartels that were born, on average, later than the cartels in our baseline sample. The larger sample contains information only on the use of *Pricing*, *Market-allocation*, and *Non-competition/specialization*. In this sample, 89% of the manufacturing cartels use at least one of these three most common MPA clauses. Moreover, in the large sample, 37% of the manufacturing cartels use *Pricing* as opposed to the 58% of cartels in our sample; 27% use *Market-allocation* (27% in our sample) and 52% use *Non-competition/specialization* (39%). As in our smaller sample, these MPA-clauses are negatively correlated. The differences to the cartels *outside* manufacturing are larger: These use *Pricing* clearly more often (78%), and *Market-allocation* and *Non-*

competition/specialization less often than the manufacturing cartels (6% and 22%). There is thus a reason to think that non-manufacturing cartels use different contracts than manufacturing cartels, but within manufacturing our sample seems representative of the larger sample.

Our findings augment those in the existing literature. Suslow and Levenstein (2011), using a sample of illegal international cartels report that a much higher percentage (80% against out 27%) use market allocation. At the same time, earlier studies looking at illegal U.S. cartels report numbers very similar to ours.[26] Further, in Levenstein and Suslow's (2011) sample 31% of cartels involve a trade sales association (52% in our data; the older studies cited in footnote 26 report 29-44%). One third of their cartels adopt some compensation scheme, in our data, the clause *Enforcement* comes closest; it is adopted by 12% of cartels. However, 31% adopt *Expel* and 15% adopt *Fine*.[27]

Comparing the characteristics of the cartels in our sample to those studied by Harrington (2006) we find more heterogeneity. All cartels in Harrington's sample agree on prices, and, though this is more difficult to judge, it seems that the cartels in Harrington's sample used more complex organizations than the average cartel in our sample. The former could be the result of the international illegal cartels being unable to use market allocation, as it could have led to a higher detection probability. The latter may be explained by the fact that international cartels need a more complex organization than national cartels.

Our contract characteristics are not easily compared to those recorded by Taylor (2007). Our results on the complexity of cartel contracts are however in line with his results. Using data on U.S. legal cartels from the 1930s (the National Industrial Recov-

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[26] See also Levenstein and Suslow 2006, Table II: Hay and Kelley (1974) report that 35% use market allocation; Fraas and Greer (1977) 26%, Posner (1970) 26% and Gallo et al. (2000) 27%.

[27] "Disciplinary or Coercive Practices" and/or "Exclusion" are adopted by 5% of the cartels in Hay and Kelley and by 12% in Fraas and Greer.

ery Act), Taylor also found a positive but insignificant correlation between cartel size and number of pages, and no significant relationship between pages and degree of product differentiation.

As discussed in section 3.1, these cartels in our sample were legal, but apparently they hardly ever used the legal system to enforce their cartel contracts, nor was the enforceability entirely clear ex ante. Thus, there were few reasons at the initial contracting stage to consider the degree of verifiability of the various clauses in the court of law. Using the terminology of Kaplow (2011a, pp. 803), the contracts we have studied can be seen as an exchange of promises and, perhaps, as a means to communicate the intended behavior of cartel members. It seems clear that the need of *illegal* cartels to conceal their agreements and behavior will lead to further endogenous incompleteness of contracts, because the participants have a strong incentive to strategically reduce the ability of a legal court to verify their concerted actions (see Kvaløy and Olsen 2009 and also Kaplow 2011a, pp. 758-765). From this point of view one could think that the contracts we've studied *are the type of contracts illegal cartels would like to write, had that no legal consequences*. This means that observed differences between contracts of legal and illegal cartels are likely to be due to the competition law regime that the latter face. The reasoning behind this statement is that the profit, incentive and organizational issues illegal cartel face, as well as those relating to changes in the external environment, are similar to those faced by the legal cartels that we have studied.

8   Conclusions

We have followed a three-step research approach to provide an anatomy of cartel contracts. In the first step, we pinned down the contracting approaches cartels employ. We achieved this by classifying 18 potential clauses that cartels may use when writing their contracts into different economic dimensions and by exploring the patterns of correlation between them. We add to the knowledge on cartels by taking two further steps: In

the second step, we scrutinized how the cartel contracts relate to the size of the cartel and to whether the industry produces homogenous or differentiated products. In the third step, we provided an analysis of the complexity and stability of cartel contracts.

We find that while essentially all cartels agree on some mechanism to raise joint profits, they differ in how they do this. By and large, we find three basic contracting approaches: cartels either agree on prices, allocate markets, or use some type of non-competition/specialization clause to raise profits. These are gross substitutes. Choosing one of these has implications to the rest of the contract when considering the unconditional data. For example, the *Market allocation* cartels use more incentive compatibility (ICC) and organizational (ICO) clauses, whereas *Pricing* is positively correlated with ICC and ICO, but negatively with clauses on external threats (ECC). In contrast, the *Non-Comp-Tech* contracts are negatively associated with ICC, ICO and positively with ECC in the unconditional analysis.

These unconditional correlations are however largely explained by the number of members in the cartel, and the industry producing homogenous goods. We find that *Pricing* contracts are positively and *Non-Comp-Tech* contracts negatively associated with the number of cartel members, but *Market allocation* contracts are not affected by cartel size. In contrast, only *Market Allocation* is correlated (negatively) with the degree of product differentiation. The conditional analysis also shows that the correlation structure across the MPA clauses stays more or less the same when compared to the unconditional one, but that the relations between the MPA clauses and the instability clauses change and in general become weaker. Thus, one could argue that large cartels tend to agree on prices, cartels in homogenous goods industries raise profits by allocating markets, and small cartels agree to avoid competition through specialization.

There are further differences: larger cartels use more complex contracts and cartels in homogenous goods industries appear to write shorter contracts. *Pricing* and *Mar-*

ket Allocation contracts are the most complex in terms of page length. In terms of contract dynamics, contract changes are seen more often in *Pricing* cartels and less often in *Non-Comp-Tech* contracts. These findings suggest that even relatively simple and short contracts can sustain collusion and that cartels that agree on prices have to rely on more complex contracts and subsequently update them more often.

Our findings suggest regularities in cartel contracts that can be exploited by competition authorities: Not in terms of deciding where to look for cartels and collusion (e.g. Symeonidis 2003), but in terms of what type of concerted action or horizontal agreements to expect and to search for. This knowledge should ultimately increase the likelihood of courts making a proper ruling in cases involving price-fixing and other prohibited horizontal agreements (Kaplow 2011a,b). The anatomy of cartel contracts ought also to be helpful in understanding the limits of competition and regulation (Shleifer 2004, 2012).

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Tables

Table 1: Economic dimensions and contract clauses

Panel A: Variable descriptions

Economic dimension #1: Market Power Attributes (MPA) -- 6 clauses

Pricing	*= 1 if the contract refers to prices, pricing rules, discount rules and/or rules of delivery and payment.*
Market allocation	*= 1 if the contract refers to sales quotas or market shares, exclusive territories, or allocation of customers among the members.*
Efficiency	*= 1 if the contract stipulates, e.g., that sales and/or production should be allocated according to efficiency.*
Technology	*= 1 if the contract refers toabout sharing of technological knowledge such as patents or blueprints.*
Non-price	*= 1 if the contract mentions any non-price restrictions, like add-ons, bundling, and quality.*
Non-comp./spec.	*= 1 if the contract stipulates that the members are to specialize in one way or the other, or agree to "not compete" in a given market.*

Economic dimension #2: Incentive Compatibility Constraint (ICC) -- 4 clauses

Monitoring	*= 1 if the contract has a clause on how the members monitor each other.*
Enforcement	*= 1 if the contract stipulates how to handle situations where a member has deviated or mentions price wars, retaliation, etc.*
Expel	*= 1 if the contract includes rules on how to expel a member if rules are broken.*
Fine	*= 1 if the contract includes clauses on monetary fines for a company that violates the contract.*

Economic dimension #3: Internal Cartel Organization (ICO) -- 5 clauses

Meeting	*= 1 if the contract stipulates whether, and if so, how often, the members are to meet.*
Dispute-resolution	*= 1 if the contract specifies a way in which disputes among members are to be resolved.*
Structure	*= 1 if the cartel has a formal structure, such as an association or a limited liability company to organize itself.*
Vote	*= 1 if the contract specifies a voting procedure.*
Sales	*= 1 if the cartel has formed either a trade or a sales association.*

Economic dimension #4: External Cartel Contract (ECC) -- 3 clauses

New members	*= 1 if the contract specifies a policy on how to accept new members.*
Non-cartel supply	*= 1 if the contract specifies how to deal with supply from non-member rivals.*
Entry	*= 1 if the contract stipulates how to react to entrants into the industry.*

Table 1, continued

Panel B: Usage of economic dimensions				
	Extensive margin		Intensive margin	
	# of cartels	freq.	# of clauses	freq.
MPA	105	0.96	6	0.30
ICC	57	0.52	4	0.39
ICO	93	0.85	5	0.49
ECC	80	0.73	3	0.43

Table 2: Extensive- and intensive margins for observed contract designs

Contract design	n	freq.	homogenous	Extensive margin				Intensive margin			
				MPA usage	ICC usage	ICO usage	ECC usage	MPA usage intensity	ICC usage intensity	ICO usage intensity	ECC usage intensity
1	42	0.39	0.50	1	1	1	1	0.30	0.38	0.58	0.38
2	29	0.27	0.48	1	0	1	1	0.32	-	0.39	0.46
3	9	0.08	0.56	1	1	1	0	0.30	0.50	0.49	-
4	9	0.08	0.11	1	0	1	0	0.33	-	0.36	-
5	9	0.08	0.44	1	0	0	0	0.22	-	-	-
6	4	0.04	0.25	1	0	0	1	0.29	-	-	0.58
7	3	0.03	0.00	0	1	1	1	-	0.33	0.73	0.44
8	2	0.02	1.00	1	1	0	0	0.25	0.25	-	-
9	1	0.01	0.00	1	1	0	1	0.33	0.25	-	0.67
10	1	0.01	0.00	0	0	1	1	-	-	0.60	0.33

Table 3. Prevalence of MPA clauses

MPA clause	Sample		
	All	Homogenous	Non-homogenous
	Mean	Mean	Mean
Pricing	0.578	0.525	0.646
Market allocation	0.266	0.131	0.438
Efficiency	0.083	0.098	0.063
Technology	0.284	0.344	0.208
Non-price	0.147	0.115	0.188
Non-comp./spec.	0.385	0.426	0.333
# of cartels	109	48	61

Table 4. Unconditional correlations of MPA clauses

MPA clause	Pricing	Market allocation	Efficiency	Technology	Non-price
Market allocation	-0.116	1			
Efficiency	-0.216**	0.272***	1		
Technology	-0.532***	0.082	0.180*	1	
Non-price	0.302***	0.044	-0.124	-0.147	1
Non-comp./spec.	-0.698***	0.035	0.310***	0.546***	-0.222**
NOTES: ***, **, and * refer to statistical significance at the 1, 5, and 10% levels.					

Table 5. Unconditional correlations between MPA clauses and other economic dimensions

	Pricing	Market allocation	Efficiency	Technology	Non-price	Non-comp/spec.
ICC	0.236**	0.448***	0.022	-0.151	-0.002	-0.368***
Monitoring	0.173*	0.443***	-0.012	-0.114	0.011	-0.266***
Enforcement	0.085	0.483***	0.198**	-0.044	0.087	-0.175*
Expel	0.215**	-0.002	-0.058	-0.117	-0.111	-0.289***
Fine	0.09	0.279***	-0.030	-0.089	0.048	-0.169*
ICO	0.317***	0.226**	0.05	-0.236***	-0.012	-0.370***
Meeting	-0.014	0.121	0.152	-0.115	-0.124	0.036
Dispute-resolution	-0.357***	0.339***	0.233**	0.278***	0.001	0.304***
Structure	0.316***	0.074	-0.054	-0.251***	-0.145	-0.371***
Vote	0.436***	0.082	-0.070	-0.284***	0.042	-0.412***
Sales	0.486***	0.076	-0.047	-0.334***	0.137	-0.565***
ECC	-0.293***	0.086	0.028	0.293***	-0.111	0.263***
New members	0.395***	-0.082	-0.095	-0.406***	-0.055	-0.500***
Non-cartel supply	-0.529***	0.212**	0.155	0.587***	-0.032	0.561***
Entry	-0.380***	-0.015	-0.030	0.313***	-0.099	0.417***
NOTES: ***, **, and * refer to statistical significance at the 1, 5, and 10% levels.						

Table 6. Marginal effects of MPA contract clause and other economic dimension probit regressions

	Pricing	Market allocation	Efficiency	Technology	Non-price	Non-comp/spec.	ICC	ICO	ECC
Log(members)	0.066**	-0.070	-0.102**	-0.109***	-0.069**	-0.156***	0.262***	0.186***	0.146***
	(0.032)	(0.043)	(0.046)	(0.037)	(0.030)	(0.055)	(0.043)	(0.057)	(0.042)
Homogenous_d	0.027	0.219***	-0.118**	-0.059	-0.040	-0.028	0.120	0.021	0.128**
	(0.065)	(0.066)	(0.060)	(0.070)	(0.064)	(0.089)	(0.095)	(0.058)	(0.056)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	107	107	107	107	107	107	107	107	107

NOTES: The numbers presented are marginal effect and (s.e.). ***, **, and * refer to statistical significance at the 1, 5, and 10% levels.

Table 7. Marginal effects of ICC, ICO and ECC contract clauses

	ICC				ICO					ECC		
	Moni-toring	Enforce-ment	Expel	Fine	Meeting	Dispute-resolution	Structure	Vote	Sales	New member	Non-cartel supply	Entry
Log(members)	-0.049	-0.058**	0.294***	-0.019	-0.004	0.010	0.273***	0.220***	0.115**	0.219***	-0.131***	-1.470***
	(0.031)	(0.024)	(0.036)	(0.022)	(0.015)	(0.022)	(0.040)	(0.050)	(0.052)	(0.033)	(0.043)	(0.197)
Homogenous_d	0.181***	0.083**	-0.046	-0.040	-0.053	0.053	-0.100	-0.027	-0.110	-0.089	0.078	0.142***
	(0.044)	(0.041)	(0.065)	(0.058)	(0.056)	(0.090)	(0.076)	(0.057)	(0.100)	(0.064)	(0.069)	(0.047)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	107	107	107	107	107	107	107	107	107	107	107	107

NOTES: The numbers presented are marginal effect and (s.e.). ***, **, and * refer to statistical significance at the 1, 5, and 10% levels.

Table 8. Correlations of generalized residuals of MPA clauses and other economic dimensions

MPA	Pricing	Market allocation	Efficiency	Technology	Non-price	Non-comp/spec.
Market allocation	-0.231**	1.000				
Efficiency	-0.075	0.255**	1.000			
Technology	-0.256***	0.214**	0.050	1.000		
Non-price	0.214**	-0.041	-0.060	0.024	1.000	
Non-comp./spec.	-0.359***	0.080	0.178*	0.269***	-0.159*	1.000
ICC	-0.019	0.327***	0.048	0.061	0.005	-0.133
Monitoring	0.030	0.334***	0.048	-0.027	-0.021	-0.102
Enforcement	0.020	0.395***	0.048	-0.027	-0.021	-0.102
Expel	-0.136	0.195**	0.021	0.134	0.061	0.080
Fine	0.051	0.283***	-0.019	-0.016	0.059	-0.097
ICO	0.062	0.185*	0.097	-0.090	-0.025	-0.303***
Meeting	0.138	0.063	0.185*	-0.156	-0.076	-0.104
Dispute-resolution	-0.321***	0.223**	0.109	0.241***	0.040	0.102
Structure	0.135	0.198**	0.116	-0.056	-0.209**	-0.207**
Vote	0.221**	0.181*	0.168	-0.036	0.047	-0.186*
Sales	0.192**	0.072	0.063	-0.026	0.087	-0.265***
ECC	-0.124	0.248***	-0.023	0.132	0.026	0.085
New members	0.139	-0.043	0.072	-0.192**	0.060	-0.215**
Non-cartel supply	-0.201**	0.285***	-0.005	0.387***	-0.003	0.225**
Entry	-0.019	-0.042	-0.084	0.044	-0.109	0.044

NOTES: ***, **, and * refer to statistical significance at the 1, 5, and 10% levels.

Table 9. Contract complexity and stability

Variables	(1) #clauses	(2) #clauses	(3) #pages	(4) #pages	(5) #pages	(6) #changes	(7) #changes	(8) #changes
Log(members)	0.086***	0.097***	0.132***	0.070	0.066	0.261***	0.075	-0.105
	(0.018)	(0.025)	(0.042)	(0.057)	(0.089)	(0.082)	(0.139)	(0.143)
Homogenous_d	0.106	0.065	0.019	-0.172**	-0.198**	0.437**	0.145	0.042
	(0.084)	(0.076)	(0.074)	(0.077)	(0.085)	(0.176)	(0.224)	(0.261)
Pricing	-	-	-	0.349**	0.242*	-	1.271***	1.197***
				(0.151)	(0.126)		(0.461)	(0.446)
Market allocation	-	-	-	0.333***	0.340***	-	0.241	0.272
				(0.123)	(0.114)		(0.290)	(0.354)
Efficiency	-	-	-	0.186	-0.046	-	1.038***	1.410**
				(0.119)	(0.132)		(0.399)	(0.606)
Technology	-	-	-	-0.049	-0.157	-	0.196	0.118
				(0.110)	(0.125)		(0.314)	(0.452)
Non-price	-	-	-	0.197	0.144	-	-0.511	-0.892**
				(0.129)	(0.123)		(0.326)	(0.421)
Non-comp./spec.	-	-	-	-0.026	0.021	-	-1.130**	-1.398**
				(0.111)	(0.104)		(0.559)	(0.624)
ICC_1 (= 1 if ICC > 0)	-	-	-	0.176**	0.164*	-	0.220	-0.231
				(0.088)	(0.090)		(0.323)	(0.350)
ICO_1 (= 1 if ICO > 0)	-	-	-	0.130	0.268*	-	-0.214	0.079
				(0.153)	(0.138)		(0.337)	(0.423)
ECC_1 (= 1 if ECC > 0)	-	-	-	-0.058	-0.072	-	-0.346	-0.215
				(0.137)	(0.133)		(0.288)	(0.219)
Controls	No	Yes	No	No	Yes	No	No	Yes
Observations	107	107	107	107	107	107	107	107

Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Appendix for online publication

Appendix 1: Further descriptive statistics

Table A1. Conditional medians/means of cartel characteristics

	Members	Duration	Pages	Homogenous goods	# Contract changes	# Clauses
All cartels	4	5	3	0.44	1	6
Conditioning variable						
MPA	4	5	3	0.457	1.029	6
Pricing	7	2	3	0.492	1.524	6
Market allocation	3	5	4	0.724	1.138	8
Efficiency	2	5	4	0.333	0.889	7
Technology	2	5	3	0.322	0.452	5
Non-price	4	1.5	4	0.556	0.938	6.5
Non-comp./spec.	2	5	2	0.381	0.286	5
ICC	7.5	5	3	0.491	1.333	7
ICO	5	5	3	0.441	0.968	6
ECC	4	5	3	0.45	0.863	6

NOTES: The numbers presented are the medians of the column variables, conditional on the row variable taking the value one. For homogenous goods and # of contract changes we report the mean.

Table A2. The distribution of #clauses and # contract changes

	# of cartels having:	
Count of clauses or contract changes	clauses	contract changes
0	-	58
1	6	17
2	5	19
3	10	11
4	16	3
5	15	0
6	21	0
7	15	0
8	9	0
9	5	1
10	4	-
11	1	-
12	1	-
13	0	-
14	1	-

Note: Column two displays the number of cartels with a given number of clauses (as given in column one). Column three displays the number of cartels with a given number of contract changes.

Appendix 2: Clustering of contract clauses

In this appendix, we analyze the 18 contract clauses graphically and by exploring how many contracts differ from the most popular contract types by one or two clauses.
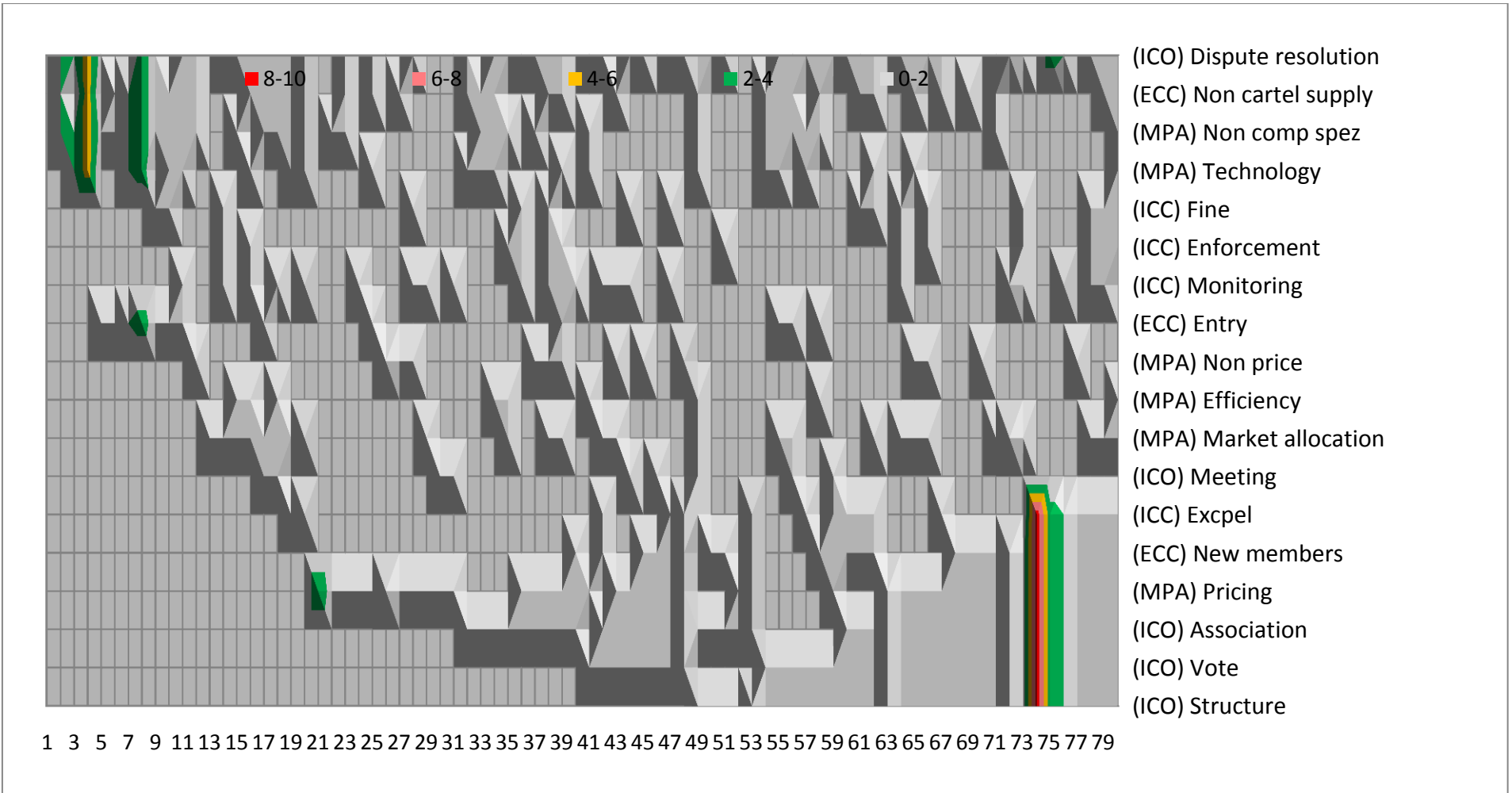
Figure A1 (see below) displays the contract data in a three-dimensional graph. The columns are the 80 contract types observed in the data and the rows the 18 contract clauses. By taking a column and reading the rows one can find out what clauses a particular cartel contract uses. The height refers to the number cartels that use a given contract clause combination. The figure supports the existence of three basic contracting approaches. Two of them are easier to identify from the graph: the group of contracts that use *Pricing* cluster in the South-East corner and the group of contracts that are associated with the amalgam of *Non-Comp-Tech* clusters in the North-West corner. The third group that uses *Market allocation* is harder to identify visually from the graph, as it is more scattered across the contracting space.

The finding of three main contracting approaches gets some support also from a formal cluster analysis, though the match is not perfect. Cluster analysis typically suggests the existence of three clusters, though this depends somewhat on the method of clustering. Another way to identify the contracting clusters is to condition on, say, *Pricing* and to ask what the most popular contracts (that use this clause) are and what other clauses such contracts have in common.

We can also look at how many contracts are "one step" away from the two most popular contracts in that they use at most one additional clause, or at most one fewer clauses. We find that there are three cartels that use a contract type that is otherwise similar to the most popular contract type, but utilizes one more ICO clause. When we look at contract types that are one step away from the second most popular contract, we find two. They both utilize one clause less (either Technology or Non-cartel supply) and are both used by two cartels. We can define being "two steps away" similarly: Two contracts are at most two steps away from each other if either contract i uses all the clauses that contract j uses, and at most 2 others; or i uses all but one of the clause that j uses, and at most one other. Using this measure, we find that 31% (34/109) of the cartels use one of the two most popular contracts, or contracts close to them.

In sum, these analyses support the finding that, by and large, there are three contracting approaches that center on the most prevalent MPA clauses.

Figure A1: Clustering of contracts

(ICO) Dispute resolution
(ECC) Non cartel supply
(MPA) Non comp spez
(MPA) Technology
(ICC) Fine
(ICC) Enforcement
(ICC) Monitoring
(ECC) Entry
(MPA) Non price
(MPA) Efficiency
(MPA) Market allocation
(ICO) Meeting
(ICC) Excpel
(ECC) New members
(MPA) Pricing
(ICO) Association
(ICO) Vote
(ICO) Structure

Legend: 8-10 6-8 4-6 2-4 0-2

1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65 67 69 71 73 75 77 79

Appendix 3: Industry- and macroeconomic effects

This appendix reports further information on how we have used industry and macroeconomic variables in the analysis. We report, in particular, how cartel contracts are correlated with industry heterogeneity and the state of the business cycle at the time the cartel is formed. This is motivated by the old question of whether collusion is more likely to be sustained and initiated during booms or busts (see, e.g., Green and Porter 1984, Rotemberg and Saloner 1986, Marques 1994 and Suslow 2005).

The industry and macroeconomic variables are defined in detail in the main text, so we do not repeat them here for brevity. However, it should be noted that for 12 industries, we miss one or the other industry characteristic. For these, we use an imputed value, which is the predicted value of the 4-digit value, the prediction taken from a regression of the 4-digit value of the industry characteristic on the 2-digit value, measured in the same year. For those couple of observations where we lack the 2-digit information, we use the 4-digit mean. We include a separate dummy (*replace_d*) for these observations in all but those equations where the outcome variable has no variation conditional on *replace_d* taking value one (or zero). Our results are robust to excluding the observations with missing industry characteristics.

Tables A3-A5 report the marginal effects for the macro- and industry heterogeneity controls for Tables 6, 7 and 9 reported in the main text. Table A3 reports how the industry characteristics and macroeconomic variables are associated with the four economic dimensions and the clauses of which they consist. We find, for example, that both industry characteristics and macro variables primarily affect use of profit (MPA) rather than the use of instability (ICC, ICO, ECC) clauses. Moreover, there are some clear differences among the most common MPA clauses: Market Allocation is not much affected by industry and cartel heterogeneity, Pricing is sensitive to macro shocks, and Non-Comp-Tech is correlated with changes in both macro- and industry heterogeneity. Table 5 reports how the industry characteristics and macroeconomic variables are associated with contract complexity and changes. It shows, for example, that none of the industry- and macro characteristics are significant in explaining the number of contract clauses. However, it seems that both the level of GDP (HP-trend) and positive macro shocks at the time of registering the cartel affect positively the number of subsequent contract changes. This suggests that cartels that are formed during a boom experience more contract changes during their lifetime.

Table A3. Marginal effects of MPA contract clause and other economic dimension probit regressions									
	Pricing	Market allocation	Efficiency	Technology	Non-price	Non-comp/spec.	ICC	ICO	ECC
Log(members)	0.066**	-0.070	-0.102**	-0.109***	-0.069**	-0.156***	0.262***	0.186***	0.146***
	(0.032)	(0.043)	(0.046)	(0.037)	(0.030)	(0.055)	(0.043)	(0.057)	(0.042)
Homogenous_d	0.027	0.219***	-0.118**	-0.059	-0.040	-0.028	0.120	0.021	0.128**
	(0.065)	(0.066)	(0.060)	(0.070)	(0.064)	(0.089)	(0.095)	(0.058)	(0.056)
Hp_trend	-0.566**	-0.300	-	-0.290	-0.036	0.021	-0.112	0.718	0.029
	(0.247)	(0.418)	-	(0.222)	(0.300)	(0.297)	(0.342)	(0.448)	(0.262)
Gdp_neg	-0.882**	0.165	0.423*	0.832***	-1.722***	1.523***	0.239	-0.018	1.073**
	(0.394)	(0.571)	(0.220)	(0.244)	(0.401)	(0.498)	(0.504)	(0.329)	(0.474)
Gdp_pos	-0.547*	-0.289	-0.126	1.118***	-0.546***	-0.013	0.187	-1.017**	1.585***
	(0.307)	(0.303)	(0.185)	(0.188)	(0.150)	(0.246)	(0.250)	(0.471)	(0.576)
Material share	-0.087	-0.361	0.339**	-0.365**	-0.242*	0.439**	-0.169	-0.446*	-0.216
	(0.264)	(0.275)	(0.145)	(0.156)	(0.130)	(0.217)	(0.283)	(0.238)	(0.297)
Hours	-0.034	0.017	-3.572*	0.176***	-0.188**	0.169***	-0.095*	0.072	0.029
	(0.079)	(0.083)	(1.872)	(0.066)	(0.088)	(0.057)	(0.054)	(0.100)	(0.067)
Gvp	0.011	0.025***	0.006	0.008	-0.007	-0.030**	0.034	-0.002	-0.008
	(0.011)	(0.009)	(0.006)	(0.006)	(0.008)	(0.012)	(0.021)	(0.005)	(0.011)
Plants	-0.084**	-0.039	0.011	0.008	-0.027*	0.073	-0.094	0.061	0.067
	(0.037)	(0.055)	(0.024)	(0.013)	(0.016)	(0.050)	(0.069)	(0.052)	(0.043)
Reg. birth	0.118*	0.072	-0.012*	0.087	-0.014	0.027	0.025	-0.148	0.010
	(0.065)	(0.113)	(0.006)	(0.062)	(0.075)	(0.074)	(0.090)	(0.112)	(0.072)
Replace_d	0.822***	0.062	1.183*	0.122	-	-0.931***	0.468	-0.604*	-0.708**
	(0.254)	(0.392)	(0.631)	(0.115)	-	(0.317)	(0.471)	(0.338)	(0.304)
Observations	107	107	107	107	107	107	107	107	107

NOTES: The numbers presented are marginal effect and (s.e.).

***, **, and * refer to statistical significance at the 1, 5, and 10% levels.

Table A4. Marginal effects of ICC, ICO and ECC contract clauses

	ICC				ICO					ECC		
	Moni-toring	Enforce-ment	Expel	Fine	Meeting	Dispute-resolution	Structure	Vote	Sales	New member	Non-cartel supply	Entry
Log(members)	-0.049	-0.058**	0.294***	-0.019	-0.004	0.010	0.273***	0.220***	0.115**	0.219***	-0.131***	-1.470***
	(0.031)	(0.024)	(0.036)	(0.022)	(0.015)	(0.022)	(0.040)	(0.050)	(0.052)	(0.033)	(0.043)	(0.197)
Homogenous_d	0.181***	0.083**	-0.046	-0.040	-0.053	0.053	-0.100	-0.027	-0.110	-0.089	0.078	0.142***
	(0.044)	(0.041)	(0.065)	(0.058)	(0.056)	(0.090)	(0.076)	(0.057)	(0.100)	(0.064)	(0.069)	(0.047)
Hp_trend	-0.093	-0.446**	-0.403	0.001	-0.102	-0.585**	0.260	0.686**	-0.140	-0.130	-0.228	-0.768**
	(0.359)	(0.223)	(0.265)	(0.305)	(0.182)	(0.290)	(0.313)	(0.271)	(0.345)	(0.371)	(0.260)	(0.372)
Gdp_neg	-0.339	-0.165	0.495	-0.168	0.195	0.935**	-0.257	-0.275	0.474	0.044	0.654**	-0.417
	(0.671)	(0.276)	(0.340)	(0.370)	(0.270)	(0.440)	(0.540)	(0.488)	(0.434)	(0.399)	(0.302)	(0.259)
Gdp_pos	-0.219	-0.418	0.513**	-0.019	-0.589**	-0.467	-0.579	-0.692	-0.360	-0.149	1.684***	0.167
	(0.385)	(0.373)	(0.228)	(0.343)	(0.258)	(0.515)	(0.432)	(0.437)	(0.371)	(0.353)	(0.395)	(0.210)
Material share	-0.222	-0.314**	0.085	-0.151	-0.235	-0.357	-0.385*	-0.143	-0.298	-0.148	-0.169	0.019
	(0.311)	(0.124)	(0.239)	(0.244)	(0.162)	(0.326)	(0.226)	(0.279)	(0.360)	(0.204)	(0.204)	(0.210)
Hours	0.099***	0.034	0.030	0.030	0.073	-0.046	-0.171	-0.211	-0.142	-0.079	0.072	-0.010
	(0.035)	(0.059)	(0.088)	(0.081)	(0.072)	(0.092)	(0.137)	(0.156)	(0.117)	(0.099)	(0.090)	(0.196)
Gvp	0.043***	0.019***	-0.018*	0.016**	0.010**	0.011	-0.031**	-0.014	0.005	0.003	-0.013	-0.007
	(0.009)	(0.006)	(0.010)	(0.007)	(0.005)	(0.012)	(0.015)	(0.010)	(0.008)	(0.009)	(0.011)	(0.005)
Plants	-0.025	-0.012	-0.076**	-0.020	-0.119*	-0.021	-0.015	-0.026	-0.038	-0.050**	0.049*	0.007
	(0.030)	(0.013)	(0.035)	(0.021)	(0.064)	(0.039)	(0.019)	(0.030)	(0.050)	(0.020)	(0.028)	(0.007)
Reg. birth	0.008	0.105*	0.118	-0.009	0.035	0.179**	-0.064	-0.187**	0.010	0.030	0.076	0.222**
	(0.095)	(0.059)	(0.072)	(0.082)	(0.050)	(0.082)	(0.086)	(0.074)	(0.089)	(0.098)	(0.073)	(0.108)
Replace_d			0.449**			-0.197	0.159	0.361	-0.089		-0.481**	0.164*
			(0.195)			(0.318)	(0.182)	(0.309)	(0.373)		(0.201)	(0.089)
Observations	107	107	107	107	107	107	107	107	107	107	107	107

NOTES: The numbers presented are marginal effect and (s.e.).

***, **, and * refer to statistical significance at the 1, 5, and 10% levels.

Table A5. Contract complexity and stability

Variables	(1) #clauses	(2) #clauses	(3) #pages	(4) #pages	(5) #pages	(6) #changes	(7) #changes	(8) #changes
Hp_trend	-	-0.247	-	-	-1.440**			-5.023**
		(0.429)			(0.592)			(2.281)
Gdp_neg	-	0.504	-	-	0.676			3.332
		(0.647)			(0.588)			(3.224)
Gdp_pos	-	-0.102	-	-	0.478			5.957**
		(0.293)			(0.491)			(3.022)
Material share	-	-0.422	-	-	-0.253			-1.069
		(0.289)			(0.402)			(0.909)
Hours	-	-0.007	-	-	-0.145			-0.820**
		(0.122)			(0.137)			(0.384)
Gvp	-	0.009	-	-	-0.007			0.004
		(0.007)			(0.010)			(0.017)
Plants	-	-0.022	-	-	0.012			0.159
		(0.024)			(0.066)			(0.104)
Reg. birth	-	0.067	-	-	0.363**			1.124**
		(0.117)			(0.154)			(0.544)
Replace_d	-	-0.010	-	-	-0.044			-2.089**
		(0.253)			(0.607)			(0.952)
Constant	1.518***	-129.368	0.950***	0.631***	-704.566**	-0.725***	-0.763	-2,182.120**
	(0.074)	(227.157)	(0.108)	(0.129)	(300.158)	(0.258)	(0.561)	(1,056.670)
Observations	107	107	107	107	107	107	107	107

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix 4: Case studies

In this appendix we provide short case studies of three cartel contracts: one *Pricing*, one *Market allocation*, and one *Non-comp-Tech* cartel case. Our choice rule was to choose the earliest registered cartel in a homogenous goods industry that uses only one of the three aforementioned MPA clauses. The cartels that emerged are the match producers cartel (Case #1), the cement cartel (Case #2), and the plywood box cartel (Case #3).

Case #1: The match producers cartel

Finnish match producers formed a pricing cartel as early as 1927. The cartel consisted of an informal (unregistered) association and the Match Industry's Price Committee, as it was called. All Finnish match producers participated in this collaborative effort, but the number of members appears to have varied a little over time; at the time of registration, it had seven members. The cartel agreed on prices, discounts to wholesale customers and cash purchases. It also agreed on the size of match boxes, and on prices of different labels on the boxes, and therefore also *Non-price* takes values one. The cartel also decided that the contract would continue on a calendar year basis unless some of the parties discontinue it. The original contract contained no further clauses. When the cartel was contacted by the Registry in 1961, it stated as its objective the "organization of domestic sales of matches". It also announced some changes to the earlier agreement that had to do with the pricing of different labels. The organizational form changed in 1971 when the Finnish Match Association was formed – thus the value of *Structure*, which in our sample is derived from the contract at the time of registration, would have changed from zero to one in 1971. The Association took over the duties of the Price Committee. The cartel continued to fix prices, but now also had a written contract which is 3.5 pages long. The contract lists the members, states that there is to be an annual meeting, and has rules on voting and exit. Moreover, the contract has a clause on dispute resolution; in case of a dispute the members would resort to arbitration by the Finnish Chamber of Commerce. The final correspondence between the cartel and the Registry is in 1986: a member of the cartel has sent a letter stating that the Finnish Match Association has not had any activities "for a number of years". The Registry therefore decides to remove the cartel from the Registry as of 1986.

The match producers cartel is an example of a relatively small pricing cartel in a homogenous goods industry. They got by for more than 40 years with a relatively simple and informal organization, and by only using a few clauses. It is notable that they did not agree on any type of monitoring at any point, not even in 1971 when they changed for a much more formal organization and added several clauses to their contract.

Case#2: The cement cartel

The cement cartel is an example of a market allocation cartel in a homogenous goods market. The two Finnish cement producers' cartel was registered in 1959. The firms announced that they had agreed to divide Finland geographically, with the smaller firm (whose market share was given as 35%) concentrating on an area that in the south was round the capital Helsinki, and extended to the north. The production facility of the smaller member was located (in 1959) west of Helsinki in the town of Lohja. Both to west and east of this area, as well as north of it was the designated area of the larger member (with a market share of 65%). The reason for this split of the market was the location of production facilities. The larger competitor had in 1959 a production facility in the south-eastern town of Lappeenranta, which allowed it to service eastern Finland with the lowest possible transportation costs (as lake transport was readily available).

The other production facility of the larger member was in 1959 in the south-west town of Parainen on the coast. This location allowed relatively cheap sea transport to the northern port of Oulu and thereby northern Finland was allocated to this member (as the other was not located on the coast). The firms also produced quicklime with 1959 market shares of 20-50% for the larger firm and 20-40% for the smaller, depending on the type of quicklime.

There was further correspondence between the Registry and the cartel in 1966. The cartel declared that no essential changes in their operation had taken place, but notified the Registry that in parts of southern Finland both producers' cement is offered. The declared market shares were now "circa 64%" and "circa 35%". There is further correspondence in 1979, indicating that the market shares had remained much the same at "circa 64%" and "32-36%". The larger cartel member states in its letter that "the marketing areas of cement are determined by customer choices, driven largely by transport costs". This cartel has the simplest contract observed by us, as they only agreed on geography-based market allocation.[1]

Case #3: The plywood box cartel

Two manufacturers of plywood boxes made an agreement in 1964 whereby one of them ceased the production of these products altogether. It also committed itself to not re-enter the business for 15 years, and to neither sell nor allow the use of its machinery. Further, it committed to not reveal its know-how of plywood box production to any domestic competitor. We therefore coded this cartel to use two more clauses besides *Non-competition/specialization*: *Non-cartel supply* and *Entry*. As compensation the firm continuing production promised to pay a royalty on its plywood box revenues to the firm ceasing production. In the correspondence with the Registry the firms stated that this agreement did not result in a monopoly, and also asked for the Registry not to publish the clause on royalties. In 1981 the Registry approached the firms and they declared that the contract had not been extended, and that also the other firm had ceased production of plywood boxes. The cartel was therefore removed from the Registry.

In sum, we find that all these cartels used relatively short and simple contracts. This is consistent with the results that we report in the main text, as all three have a small number of members and are in homogenous goods industries.

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[1] It turns out that in separate contracts, given different entry numbers by the Registry, the two firms agreed on discounts with their downstream retailers. In effect, they ensured a price-cost margin to their retailers through these contracts without agreeing on a final price for their products.