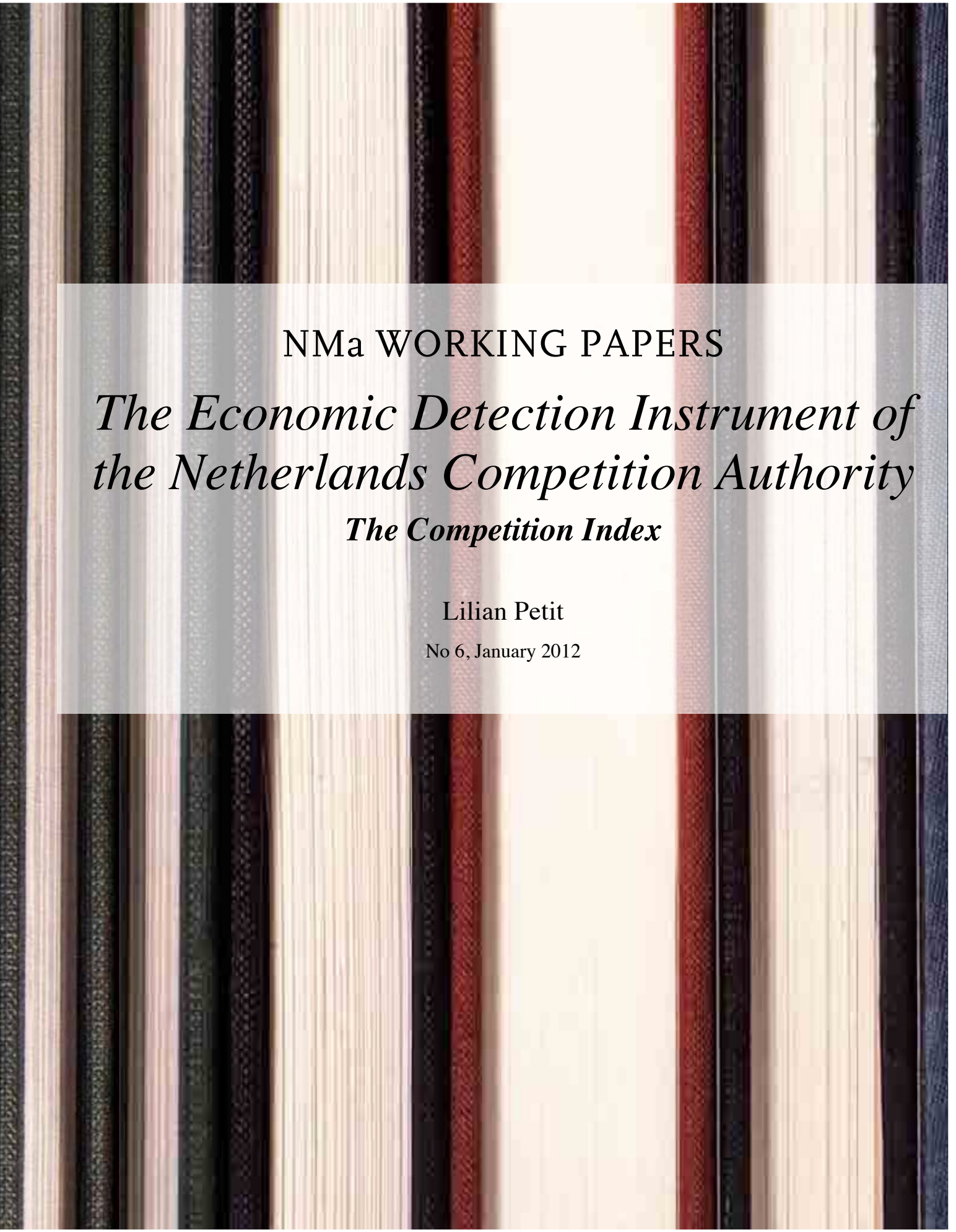

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# *The Economic Detection Instrument of the Netherlands Competition Authority*

## ***The Competition Index***

Lilian Petit

No 6, January 2012

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# The Economic Detection Instrument of the Netherlands Competition Authority

## The Competition Index

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## Abstract

This paper discusses the economic detection instrument of the Netherlands Competition Authority: the Competition Index (CI). This pro-active instrument aims to detect industries that are prone to anticompetitive behaviour. The paper firstly discusses the CI methodology. Nine economic indicators are used as a basis for this screening approach. The analysis is applied on the Dutch economy, which is divided into 500 industries for this purpose. The second part of the paper presents the results for the Dutch economy. Finally, various tests to assess the methodology are executed, as well as a sensitivity check. From these tests, we conclude that the CI produces rather robust results. The CI serves as an additional instrument to complaints, signals, whistleblowers, etc. which may be used to find possible problematic cases regarding anticompetitive behaviour.

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# Contents

## Summary

As firms become more familiar with competition enforcement practices, they begin to anticipate competition authorities' strategies. Consequently, competition authorities have to implement new and different methods and instruments in order to ensure effectiveness of enforcement. One such instrument is the Competition Index (CI). This CI is considered a pro-active approach. In combination with reactive tools like leniency requests, complaints, signals, whistleblowers, etc., a pro-active approach is desirable in order to maximize competition enforcement.

The Netherlands Competition Authority applies a method where economic theory and empirical insights are the building blocks for the methodology. The CI consists of nine indicators that all relate to competition. These indicators are considered indicative for the likelihood of anticompetitive behaviour. The CI evaluates the industries on the basis of public data. The following indicators are adopted in the analysis: number of trade associations, product prices in the Netherlands versus European Union-averages, Herfindahl-Hirschman index (HHI), number of firms, import rate, market growth, churn rate, survival rate and R&D as a percentage of sales. The raw numbers that are provided by the indicators, as applied to each industry, are standardized into comparable numbers between zero and one. A score of "0" indicates a very low, or even absent, likelihood of anticompetitive behaviour, while a score of "1" implies that an industry is prone to anticompetitive behaviour and may warrant further investigation. A weighted average of those numbers results in a ranking list of all the industries adopted in the analysis. The subset that appears high on the ranking list may contain cartels. However, this subset may also include sectors where conditions possibly conducive to anticompetitive behaviour are satisfied, but which are not in violation of the competition law. Nevertheless, since both groups cannot be distinguished by the CI, the high-score-subset requires additional attention.

The analysis is executed for the Dutch economy, which is divided into 500 industries for this purpose. The manufacturing sectors represent the top of our ranking list. For the calculation of the CI, three different weighting schemes are applied to test the sensitivity of the results. A correlation analysis shows us that the results of the three methods are rather

robust. Furthermore, it seems that evidence of refused exemption requests in the past may be indicative for the current CI scores.

So far, little is known about similar approaches that are utilized by other competition authorities. Studies often focus on specific sectors. The key advantage of the CI compared to these other studies is that the entire economy is subject to scrutiny. In addition, the methodology is easy to apply and it requires little capital and labour input. One of the criticisms of the CI is that the demand side is not included in the analysis. Future research might be directed at incorporating this variable, as well as applying the CI at a less aggregated industry level.

# 1 The need for a complementary detection instrument

## *1.1* Background

The primary activities of a competition authority are to detect and deter cartels, prevent abuse of dominance, and analyze and license mergers.[1] Gradually, authorities and firms learn from previous events or decisions and seem to use that knowledge to anticipate each other's behaviour in the future.[2] As firms become more and more familiar with competition enforcement practices, competition authorities have to implement new methods to be effective.[3] The Netherlands Competition Authority (NMa), for instance, has developed the Competition Index (CI) for its cartel detection and deterrence objective. This Competition Index functions as a data screening device in order to detect industries that are prone to anticompetitive behaviour.

### Input for cartel detection

The CI is considered a pro-active instrument for competition authorities, while the instruments whistle-blowing and leniency have a reactive nature. Depending solely on whistle-blowers or leniency might be problematic. Banisar (2006) mentions three problems inherent to whistle-blowing[4]: the fear of retaliation, legal liability and cultural barriers. As regards leniency, Brenner (2009) argues that the option of filing a leniency request in itself does not necessarily destabilize cartels. At various international conferences on competition law, more and more experts have expressed their concerns about the apparent lack of growth in the number of leniency requests.[5] Another problem may be that potential cartel members anticipate the leniency programs, and strengthen the cartel's rules to punish cheaters accordingly (Andeweg *et al.*, 2009). In summary, a diverse

[1] In European competition law, the prohibition of cartels is stated in article 101 (TFEU). Article 102 (TFEU) prohibits the abuse of a dominant position. Legislative (EU) texts for mergers are mainly stated in the EC Merger Regulation and the Implementing Regulation.
[2] See for instance American FCC Spectrum Auctions (1994-98) where parties signalled their preferred market number by referring to it in the last 3 digits of their bids (Cramton and Schwartz, 2002). Or the German DCS-1800 Auction 1999 (cell phone spectrums) where Mannesmann signalled it would like to share bidding blocks for a price of 20 million DM by bidding 18,18 so that T-mobile could raise its bid to 20 (minimum obligatory raise was 10 percent), (Motta, 2004).
[3] This problem is also highlighted by Schinkel (2010); in his inaugural lecture he metaphorically refers to a cat-and-mouse-game.
[4] Whistle-blowing can be defined as "*An act of a man or women who, believing that the public interest overrides the interest of the organization he serves, blows the whistle that the organization is involved in corrupt, illegal, fraudulent or harmful activity*" (Nader, Petkas and Blackwell, 1972, p. 28).
[5] Also mentioned by Hüschelrath (2010).

set of detection approaches (reactive and pro-active) is desirable to enhance competition enforcement.

Economic detection has a twofold relevance. Firstly, to identify industries prone to anticompetitive behaviour and therefore meriting extra attention. Secondly, to deter cartelization and destabilize cartels. The idea of an additional (pro-active) detection method is that it increases the likelihood that cartelizing firms will get noticed (Hüschelrath, 2010). Due to the (perceived) increased risk of getting fined, the expected profits of cartelization decrease. Consequently cartelization becomes less attractive (Motta, 2004). The following quotation highlights that an increase in the detection-rate is desirable, since the detection-rate in the European Union is rather low.
*"Our detection duration is about 7 years and a new cartel, which will eventually be detected, is born every 6 months. The probability of getting caught in a given year, conditional on being detected, is between 12.9 % and 13.2 %, which represents an upper boundary to the global probability of detection"* (Combe, Monnier and Legal, 2010, p. 17).

### *1.2* **Research question and scope**

The previous section underlined the need for a screening detection approach that is complementary to reactive instruments. The central question here is:

*What does a detection method look like, that is in accordance with economic theory, and takes into account* ***all*** *the sectors in a national economy based on data that are:*

I. ***objective****,*
II. ***comparable****,*
III. ***publicly available*** *and*
IV. ***difficult*** *to* ***manipulate*** *by the source?*

It is necessary to study the whole economy, this helps to prioritize sectors for a competition authority. Furthermore, the data should not be open for discussion, therefore we demand objectivity. In addition, it is essential that the data are comparable, so we can compare the sectors. In order to maintain the transparency, the data should be publicly available. Finally, to generate robust outcomes, the data should be difficult to manipulate.

It is tempting to assume that the purpose of such a method is to "pinpoint cartels". However, this goal would be too ambitious. In fact, we aim to make a selection of industries where the risk of anticompetitive behaviour might be higher than in other industries. In other words, we aim to screen the economy for industries that are prone to anticompetitive behaviour. Obviously this subset of industries may contain cartels. However this subset may also include sectors where the conditions for anticompetitive behaviour, according to our standards, are satisfied but there is no violation of competition law. On the other hand, it might well be the case that existing cartels are considered unlikely by our CI. The CI therefore involves 'false negatives', i.e. cartels in industries which are not identified by the CI as being possibly uncompetitive. 'False positives', i.e. industries are identified as possibly prone to being anticompetitive, but do not contain cartels, are not a problem. Their possible anti competitiveness merely triggers further investigation, hence it may well be that no cartel is found or can be proved. An example of how the CI indicator can better be used to identify industries, worthy of further scrutiny, rather than to pinpoint cartels, was the result generated by the CI calculation on the mortgage market in the Netherlands in 2011. In response to some signals, the NMa undertook a sector study in 2011. Although the CI calculation signaled that the market was prone to anticompetitive behaviour, the sector study undertaken by the NMa, did not identify a violation of the competition law. Nevertheless, the indicator highlights that such sectors should be watched carefully, as there may be a risk of future anticompetitive issues.
The CI functions as a screening device and focuses on circumstantial evidence. It is thus essential to undertake additional extensive research in order to make a final judgement about actual behaviour and violations of competition law.

The remainder of this paper is structured as follows. In section 2 we discuss the theoretical background. Two strands of relevant literature for the CI are discussed, the screening literature and the literature on collusive or competitive markers. Section 3 describes the methodology of the Competition Index.[6] Section 4 presents the empirical results of the CI for 2008. Subsequently section 5 outlines various analyses of the results. The final section concludes and sets out suggestions for further research.

[6] The Competition Index used by the NMa was actually introduced in a Master-thesis study by Vermeulen (2007) and published in an NMa discussion paper (Buijs and Vermeulen, 2008). In 2011 an update of the results was published in Economisch Statistische Berichten (see Petit and Van Sinderen, 2011).

# 2 Literature review

This section provides an overview of the relevant literature concerning economic detection. Firstly, it elaborates on detecting anomalies in general. Secondly, various studies in the screening literature will be discussed. Finally, we will discuss some characteristics and indicators that may point to competition or collusion.

### Anomaly detection

Chandola, Banerjee and Kumar (2009) provide an overview of a wide range of detection-techniques in their study '*Anomaly Detection: A Survey'*. The authors state that: "*Anomaly detection refers to the problem of finding patterns in data that do not conform to expected behavior*". Chandola *et al.* (2009) claim that detecting outliers or anomalies in datasets was already practiced in the 19th century by Edgeworth (1887). Several areas of anomaly detection are mentioned in their study, e.g. credit card fraud, health care, insurance, intrusion detection for cyber-security, etc. Besides the major issue of data collection, defining a "normal region" or "anomaly region" is said to be one of the main challenges of anomaly detection. Anomalies can be declared in certain ways, one could use for instance a nearest neighbor technique or a cluster analysis to focus on the density of observations or a statistical approach like a boxplot, etc. (Chandola *et al.*, 2009).

### Cartel detection

A time-series of price data allows one to screen for anomalies regarding price agreements. In the literature, we see that a variance screen of prices is a frequently used method in order to identify possible price agreements. Abrantes-Metz and Bajari (2009) state the following: "*A cartel can be thought of as a "filter" that attenuates cost shocks before passing them to price, thereby reducing price variance*" (p 13). In general, a higher price level attended with a lower variance is indicative for collusion. Various studies examine how prices are affected by collusion, among which: Abrantes-Metz *et al.* (2006), Connor (2005), Bolotova *et al.* (2008), Blanckenburg and Geist (2009) and Blanckenburg *et al.* (2010).

Recall that the purpose of our CI is to detect industries where the conditions are conductive to anticompetitive behaviour and therefore merit extra attention. One could question whether price screening completely captures the behaviour of cartels. Agreements

may also include product differentiation, geographic market partition, innovation activities, exchange of information, agreements on standards, etc. Obviously, the primary purpose of a cartel is to increase profits, but this does not necessarily end up in price changes.

In line with the preceding, Abrantes-Metz and Bajari (2009) highlight the existence of screenings that aim to identify market partition, i.e. cartels concerning quantities. The authors state that there are basically two types of screens in the literature. Firstly, screens focussing on highly stable market shares. Harrington (2006) defines this collusive marker as follows: "*There is a subset of firms for which each firm's share of total supply for that subset of firms is highly stable over time*" (p. 11). Secondly, there are screens that focus on a negative correlation among the market shares, i.e. a deviation that results in a high market share, is followed by compensation (lower market share) in the succeeding periods.

Lorenz (2008) employs a model that analyses markets on the basis of time pattern analysis, and investigates whether they operate efficiently. Five relevant processes are identified: the market clearing process, the rate of return normalization process, the erosion of market power process, the product innovation process and the technology innovation process. The workflow of this cartel audit consists of two steps: first a short data screen, and in the case of suspicious outcomes, a second intensive data-screen is executed.

An econometric model in order to predict cartels is estimated by Grout and Sonderegger (2005). Based on the characteristics of prosecuted cartels they identify a set of collusive markers (these are listed below). The authors apply these markers to other industries to forecast cartels. A caveat of this approach is that it screens for the characteristics of failed and/or discovered cartels. It might well be the case that the characteristics of a robust and well organized cartel are different.

Another issue regarding cartel detection is the detection of bid-rigging: collusion in tenders. Porter and Zona (1997) find that in case of collusive behaviour (for school-milk procurement), there is correlation between firms' entrance decisions. If one of the undertakings submits a bid, then the other cartel participants will also submit a bid, and furthermore, the levels of the bids tend to move together. Bajari and Ye (2003) study the bids of highway contractors. The authors state that firms' costs, i.e. travel costs/distance to execute the job, are highly informative for the analysis of the bid's competitiveness.

Friederiszick and Maier-Rigaud (2007) discuss the importance of economic detection in their study. Among other themes, the authors identify four criteria that need to be satisfied for the implementation of a successful method. First of all, a detection method should not be easy to circumvent. Secondly, it has to take into account the capabilities and resources of a competition authority and the reliability of (public) market information. Furthermore, the limitations of publicly available information have to be taken into account. Finally, the method must have the potential to detect, and consequently to deter, cartels. The authors distinguish between two methods of economic detection, a top-down approach and a bottom-up approach. Top-down approaches "*screen several sectors in order to identify industries prone to collusion*" (p. 15), while the bottom-up approach "*focuses on a particular sector or market*" (p. 16). Overall, the authors prefer the bottom-up to the top-down approach, mainly because of the difficulties of meeting the legal burden of justifying inspections. Yet, top-down screening is not per se designed for this objective and indeed is insufficient to warrant inspections, but it may generate fruitful further investigations. Top-down screening aims at screening the whole economy at once, not excluding any industry in advance.

### (Anti) competition markers

Restriction or distortion of competition has a reasonably straightforward legal definition (see for instance article 101 (TFEU)). Whereas explicit collusion is expressly forbidden by law, tacit collusion is harder to prove. Nevertheless, it may be very restrictive of competition (and worth monitoring) from an authority's point of view. Unlike the definition of a cartel, the definition and characteristics of competition, and therefore its measurement, are rather ambiguous. As mentioned earlier, several studies aim to capture the behaviour and structure of a competitive or collusive market. These studies often refer to collusive or competitive "markers".

Table 2.1 provides a list of indicators that have been identified as markers for competition or collusion. A large set of indicators has been explored, developed and tested in order to measure the degree of competition or its absence. The Herfindahl-Hirschman index (HHI) is perhaps the most common measurement tool in this field. The indicators depicted in table 2.1 focus on the characteristics of markets at the industry-level. However, there are also studies and reports that aim to measure the competitiveness at national level (see for

instance Høj (2007), Van Sinderen and Bakker (2010) and the annual Global Competitiveness Reports). Nevertheless, the focus here is on industry-level analysis.

Although table 2.1 does not claim to be comprehensive, it contains a selection of leading indicators and studies that give an impression about the type of indicators that are used. The indicators are divided into eight groups: barriers, concentration, interaction, productivity/innovation (prod./inn.), profits/prices, stability/symmetry (stab./symm.), demand and other (see the first column). The second column enumerates the indicators. Indicators that also appear in the CI method (generally or specifically), are flagged with an asterisk. Section 3.3 discusses those indicators in more depth. The third column depicts the expected effect of the indicators on competition. The corresponding references are listed in the fourth column.

**Table 2.1 Competition/ collusive markers[7]**

| Group | Indicator | Effect on competition | Reference |
|---|---|---|---|
| Barriers | High advertising intensity | + | Symeonidis 2003 |
| Barriers | High capital intensity | - | Symeonidis 2003 |
| Barriers | Entry barriers* | - | Motta 2004 |
| Barriers | Low churn rate* | - | NERA 2004 |
| Barriers | High entry barriers* | - | Grout and Sonderegger 2005 |
| Barriers | Free entry and exit* | + | Perfect competition |
| Concentration | Concentration (Cn ratio and HHI)* | - | Motta 2004 |
| Concentration | Concentration* | - | NERA 2004 |
| Concentration | Concentration* | - | Grout and Sonderegger 2005 |
| Concentration | Concentration* | - | Levenstein and Suslow 2006 |
| Concentration | Low number of competitors* | - | Rey 2006 |
| Concentration | High HHI and equivalence number* | - | Lorenz 2008 |
| Concentration | Many organizations* | + | Perfect competition |
| Demand | High demand elasticity | + | Motta 2004 |
| Demand | Stability of demand | - | Motta 2004 |
| Demand | Consumer complaints | - | NERA 2004 |
| Demand | Buying power | + | Rey 2006 |
| Demand | Low demand elasticity | - | Rey 2006 |
| Interaction | Trade associations* | - | Martin 2001 |
| Interaction | Cross ownership | - | Motta 2004 |

[7] This table is based on Buijs and Vermeulen (2008).

| Group | Indicator | Effect on com-petition | Reference |
|---|---|---|---|
| Interaction | Multi-market contact | - | Motta 2004 |
| Interaction | Communication* | - | Porter 2005 |
| Interaction | Industry associations* | - | Levenstein and Suslow 2006 |
| Interaction | Cooperative and other contractual agreements | - | Rey 2006 |
| Interaction | Frequent interaction between the firms* | - | Rey 2006 |
| Interaction | Multi-market contact | - | Rey 2006 |
| Interaction | The absence of club and network effects | - | Rey 2006 |
| Other | Regularity and frequency of orders | - | Motta 2004 |
| Other | Import penetration* | + | NERA 2004 |
| Other | High market transparency | - | Rey 2006 |
| Prod./inn. | Innovation* | + | NERA 2004 |
| Prod./inn. | Low productivity | - | NERA 2004 |
| Prod./inn. | High employee costs | - | Grout and Sonderegger 2005 |
| Prod./inn. | Market share of new products (innovation lag) | - | Lorenz 2008 |
| Prod./inn. | Low labour productivity | - | Lorenz 2008 |
| Profits/prices | High prices* | - | NERA 2004 |
| Profits/prices | Existence of buyer power | + | Motta 2004 |
| Profits/prices | Stable turnover* | - | Grout and Sonderegger 2005 |
| Profits/prices | High, stable prices* | - | Harrington 2006 |
| Profits/prices | Excess rate of return | - | Lorenz 2008 |
| Profits/prices | Seldom and high volatile changes in prices, in cycl. downturns price fixed. | - | Lorenz 2008 |
| Profits/prices | Profit elasticity | + | Boone 2008 |
| Profits/prices | P=MC | + | Perfect competition |
| Stab/symm. | Product homogeneity | - | Motta 2004 |
| Stab/symm. | Symmetry | - | Motta 2004 |
| Stab/symm. | Inventories and excess capacities | - | Motta 2004 |
| Stab/symm. | Number of players is stable* | - | Grout and Sonderegger 2005 |
| Stab/symm. | Absence of significant fluctuations or business cycles* | - | Rey 2006 |
| Stab/symm. | Stable quantities, stable market shares* | - | Harrington 2006 |
| Stab/symm. | High demand stability* | - | Levenstein and Suslow 2006 |
| Stab/symm. | Market growth* | - | Rey 2006 |
| Stab/symm. | Mature industries with stabilized technologies* | - | Rey 2006 |
| Stab/symm. | Product homogeneity | - | Rey 2006 |

| Group | Indicator | Effect on competition | Reference |
|---|---|---|---|
| Stab/symm. | Symmetric capacities | - | Rey 2006 |
| Stab/symm. | Symmetric costs | - | Rey 2006 |
| Stab/symm. | Low capacity utilization | - | Lorenz 2008 |
| Stab/symm. | Dysfunctional growths of capacities | - | Lorenz 2008 |
| Stab/symm. | Low volatility of market shares* | - | Lorenz 2008 |
| Stab/symm. | Homogenous products | + | Perfect competition |

As mentioned in this literature overview, the concept of economic detection is used in many studies. Among these, there are however a few studies that apply a top-down approach. Within the literature of economic detection a large set of indicators has been explored, developed and tested in order to measure the degree of competition, or the likelihood of anticompetitive behaviour. Section 3 discusses the CI methodology and will elaborate on the indicators that are adopted in the Competition Index.

# 3 Competition Index

The Competition index as developed by the NMa is composed of nine indicators that relate to competition, see section *3.1*. The raw numbers of those indicators per industry are standardized into comparable numbers between zero and one, as set out in sections *3.2* and *3.3*. A weighted average of those numbers, as explained in section *3.5*, results in a ranking list of all industries in the Dutch economy. This is presented in section *4*.

Obviously, one should address the strategic consideration of making the CI's methodology public. Transparency implies that firms know about this competition enforcement strategy. Friederiszick and Maier-Rigaud (2007) claim that: "*Communicating to the industry that the competition authority is actively pursuing a cartel detection policy and that it is well aware of economic tools available to support such a policy will clearly contribute to cartel deterrence*" (p. 14). This is in line with Motta's (2004) argument that cartelization becomes less attractive because use of the Index leads to a perception among would-be cartel participants of increased detection. Furthermore, the CI methodology is rather relatively resistant to manipulation. It is difficult to influence the input data in such a way that the poor functioning of the market can be concealed. If firms wanted to manipulate the outcome of the CI, they would need to adopt a competitive market structure . That, in itself, would likely negate the cartel's effects, thereby eliminating the antitrust problems.

## *3.1* Construction of the Competition Index

The composition of the CI is depicted in figure 3.1. The nine indicators can be ordered into four main categories:

1) Degree of organization: Number of trade associations
2) Prices: Prices NL versus EU
3) Concentration: HHI, number of firms and import rate
4) Dynamics: Market growth, churn rate, survival rate and R&D rate

The individual indicators and their relevance to the likelihood of anticompetitive behaviour will be extensively discussed in section 3.2. Unlike the first and second category, the third and the fourth category contain more indicators. In these categories, a variety of appropriate indicators were available. Therefore we compressed these various indicators

into one category. The weighting coefficients allocated to the categories and indicators take their relative importance into account (section 3.4 elaborates on this).

**Figure 3.1 Components of the Competition Index**


## *3.2* Membership functions

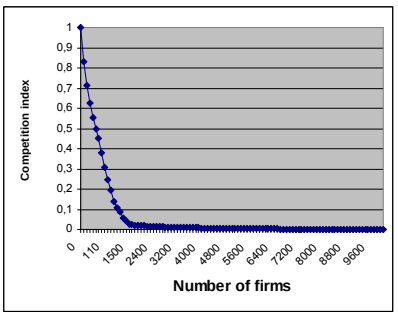
Given a dataset with different indicators and underlying numbers, it is essential to generate a final statement about the (potential) competitiveness of a particular industry (i.e. the CI). In order to generate this statement we use an indexation methodology. Although there are other approaches e.g. a filter approach, we consider an index number the most appropriate output. An indexation methodology, for instance, facilitates comparison and is easy to interpret. Before this aggregation-process is executed, an assessment per indicator is required. If one simply aggregates absolute numbers, comparison of the results is complicated. An alternative is to use relative numbers, for instance a ranking method. The disadvantage of ranking is that the performance of an industry depends on the performance of other industries. Additionally, a ranking approach does not take into account the absolute differences. It might well be that ranks 1 – 10 are absolute numbers in the range 1 – 1,5 while the ranks 11 – 20 have an absolute range of 1,5 – 15. If we apply membership functions (or fuzzy sets), we bypass the above mentioned problems. Membership functions generate a standardized output “Y”, for every raw input number “X”. Box 1 illustrates the concept of membership functions.

**BOX 1: Membership functions**

As mentioned in the literature review, competition comes in several forms and several degrees. When assessing a market the judgement is not binary: a market is not strictly "competitive" or "not competitive". Furthermore, there is no general rule of conduct for competition. Its assessment is to some extent subjective. Fuzzy sets are sets that circumvent the zero-one membership allocation of relevant characteristics: these can partially belong to a set (based on, for instance, subjective valuation) (see also Ragin, 2000).

An example can be instructive. Suppose we are asked to define the set of "age implying being young". Is '20' young or not? A normal set needs to strictly include this number or not, but a fuzzy set could include '20' to a certain extent, for example by the fraction of people that consider '20' indeed young. If this percentage is 0,5, then the fuzzy set includes as an element the pair (20; 0,5). Age '1' has membership value '1' and age '80' has value '0'; those are strictly included and excluded respectively.

By the use of membership functions we can determine to what extent an absolute value belongs to each set. An advantage of this technique is that it transforms absolute input into comparable output numbers. In order to asses to what extent each of our nine indicators can be qualified as competitive, see the following example relating to the number of firms in an industry.




When dealing with the indicator, 'the number of firms' we state that competition is weak when there are few firms in the market: membership value '1'. Competition becomes more likely when the number of firms increases. When there are 1500 firms, or so we state that sensitivity to anticompetitive behaviour is 0. So, membership functions allow for "subjective relationships". Consequently those relationships become debatable. Nevertheless, we apply this concept for the CI because it seems the most suitable alternative. The central question is: What input figures can justify the result of "not prone to anticompetitive behaviour", "prone to anticompetitive behaviour" and all the degrees of competition between those two extremes.

The concept of membership functions is a building block for computing the CI. Every variable has its own fuzzy relationship. The raw data are transferred into numbers between zero and one, where zero indicates a likelihood of anticompetitive behaviour being absent, and an outcome of one indicates the likelihood of anticompetitive behaviour being present. The relationship between anticompetitive behaviour and the indicator is based on literature- and empirical research, as elaborated on in section 3.3.

## *3.3* Description of the indicators

This section discusses the mechanism behind each of the nine indicators and discusses the corresponding membership functions. As mentioned before, the Competition Index was introduced in Vermeulen (2007) and Buijs and Vermeulen (2008). Nine indicators were selected based on the relevance to competition and the availability of data. The indicators cover the categories as introduced in section 3.1: degree of organization, prices, concentration and dynamics. Nine indicators were considered representative for the functioning of a market.[8]

### Indicators

*The number of trade associations:* The presence of even one trade association in an industry, may be sufficient to serve as a platform to initiate or control anticompetitive practices (i.e. information exchange).[9] Levenstein and Suslow (2006) claim that "*Between a quarter and a half of the cartels in U.S. cross-section studies report the involvement of trade associations*" (p. 71). In general, we assume that the existence of even one single trade association makes a significant difference, compared to the absence of a trade association. Every additional trade association has a marginal positive effect on the likelihood of anticompetitive practices. The reasoning is that the probability of meeting relevant competitors in a more specific trade association increases with the number of trade associations in an industry.[10]

*Prices NL versus EU:* If there are high prices, in a particular market, in the Netherlands, compared to other comparable countries, one could doubt whether the market functions optimally. Economic theory states that if prices are higher in one country, competitive pressure will discipline those prices to an equilibrium level (ceteris paribus). I.e. consumers will buy the product elsewhere. If the international prices are more or less similar this could indicate a well functioning market or an international anticompetitive agreement (price fixing). If, on the contrary international prices are different, a diverse set of causes can offer an explanation. It could indicate a national cartel, it could point at a lack of international discipline due to import barriers (i.e. tariffs or taxes) and furthermore loyal or even inert consumers can cause relative price differences. National demand differences for goods or services can offer an explanation as well. Despite the diversity of causes we

[8] For more information regarding the selection of the nine indicators see Vermeulen (2007) and Buijs and Vermeulen (2008).
[9] The lysine cartel is a typical example of this: a trade organization was established in order to arrange meetings (http://www.justice.gov/atr/public/speeches/212266/c.htm).
[10] The number of associations per industry is adjusted to the number of underlying sectors within the 4 digit industry. A 4 digit industry with 3 underlying 5 digit sectors is assumed to have more trade associations than a single 4 digit industry. The raw input is (# tr. ass / # underlying sectors).

assume that industries with a higher level of prices are worth a more thorough investigation because it may be a result of anticompetitive behaviour.

*Herfindahl Hirschman index (HHI):* The HHI measures the concentration and (a)symmetry of an industry based on market shares. If the number of firms increases, the HHI decreases. If the asymmetry of the industry rises (i.e. a skewer distribution of market shares), this results in an increase in the HHI. We assume that the higher the HHI, the less competitive a market is, or potentially can be.[11]

*Number of firms:* The smaller the number of firms, the easier it is to avoid competition (ceteris paribus). In general: more firms imply more competition. Yet, this reasoning has a so called "negative exponential slope". The likelihood of anticompetitive behaviour within an industry of 5 firms is significantly more present than in an industry with 50 extra (i.e. 55) firms. However the marginal effect with 900, 1000 or 10.000 firms is rather small. An agreement among 900 firms (or more) is not very plausible. In the case of overestimating the size of the relevant product market, the indicator "number of trade associations" might rectify this, in the final CI calculations. More underlying relevant product markets will probably contain more trade associations. More trade associations will raise the final CI score.

*Import rate:* A high import rate signals that the product is internationally available. This may imply international competitive pressure. Regarding the issue of relevant markets, this variable is to some extent complementary to the HHI indicator. The HHI is calculated at national level. If the industry's relevant geographic market extends beyond this area, the HHI calculations may be overestimated. However, in international geographic markets there will be import. The existence of import will rectify the overestimated HHI in the final CI calculations: a high import rate will rectify over-high HHI scores.

*Market growth:* Market growth is closely related to the stability of the market and hence the stability of the (potential) agreements. This reasoning implies a bell-shaped curve. We basically distinguish three states of economic climate: moderate growth (stability), decline, and growth. In the situation of moderate growth, anticompetitive agreements have a solid basis: firms can monitor each other relatively easily and there are fewer incentives to deviate. Although there is an incentive to collude in a significantly declining market, firms will often fail in their collusion attempts, due to the prevailing economic problems. In

[11] Although the HHI is often used as indicator for measuring competition, its use also has some disadvantages. The indicator assumes that an increase in a market share is always bad for competition. Even if this increase is as a result of efficiencies and in fact points at a fiercely competitive market. However, in general we see that a decrease in the HHI indicates a decrease in the risk of inefficient market outcomes (Motta, 2004).

situations of economic decline, not even collusion can offer a way out. In situations of accelerating growth, collusion may be difficult to accomplish, as market entry may be more likely. Additionally there exists a monitoring problem in the case of both growth and decline: are individual market share decreases due to deviations from collusion by firms, or due to fluctuations in market demand?

*Churn rate:* The churn rate is a typical indicator for the dynamics of an industry. It measures the number of firms entering and exiting (without distinguishing between entry and exit) compared to the number of firms present in an industry. The higher the churn rate, the more dynamic the industry, and consequently, the lower the probability of anticompetitive behaviour. The churn rate can also indicate the presence or absence of entry and exit barriers. In the case of a high churn rate, entry and exit barriers can be considered to be low. Low entry and exit barriers positively influence the conditions for competition.

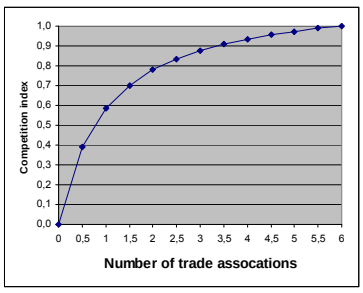
*Survival rate:* The survival rate measures the number of firms that has been active for at least the previous four years, in relation to the average existing number of firms for those years. A high survival rate implies repeated interaction among firms. If, for instance, all of the "few" existing companies were the only ones present in the market, for the previous four years, that might suggest possible communication, or at least mutual knowledge of the firms' strategic decisions (and therefore effortless anticipation of each other's behaviour). Furthermore, the survival rate can also serve as a proxy for the entry and exit barriers. The absence of entrants or leavers (i.e. a survival rate of 1) suggests high barriers and may impede effective competition. The survival rate and the churn rate are, to some extent, similar. This aspect is incorporated in the weighting schemes.

*R&D rate:* Highly innovative markets are less prone to anticompetitive practices. Firms with high R&D expenses are assumed to be mutually competitive to obtain a "first movers advantage". The absence, or avoidance, of R&D expenses might point to possible collusive behaviour.

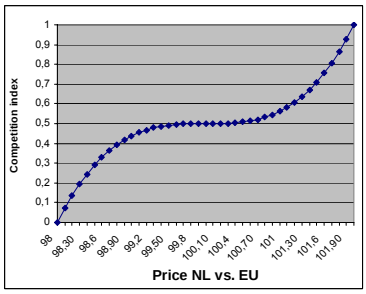
### Membership functions

Section 3.2 already introduced the concept of membership functions. The slope of the membership functions is determined, based on empirical insights and literature (see also Buijs and Vermeulen, 2008). The reasoning behind these slopes has been explained in the previous discussion of the separate indicators. In the following, a brief discussion of the individual slopes is outlined:

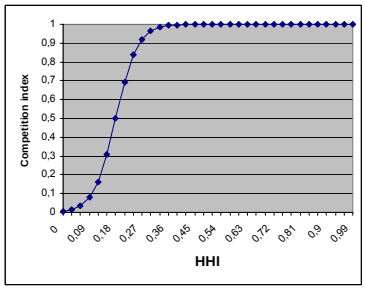
*Graph 1* illustrates that every additional trade organization in an industry has a marginal negative effect on competition. *Graph 2* depicts the moderate score that results from price indices in the range 99 – 101. All other price indices tend to result in a finding of either "detrimental to competition" (>101) or "beneficial to competition" (<99). *Graph 3* shows that a HHI score exceeding 2000 (due to scaling this number is visualised as 0,2 in the graph) becomes problematic. *Graph 4* shows a linear relationship between the number of firms and the likelihood of anticompetitive behaviour in the range "0 – 1500 firms". If the number of firms exceeds 1500, the likelihood of anticompetitive behaviour is excluded. *Graph 5* visualises that import rates lower than 70 increase the likelihood of anticompetitive behaviour. *Graph 6* shows that a stable market with moderate growth increases the likelihood of anticompetitive behaviour. *Graph 7* indicates that industries with a churn rate under 1 are more prone to anticompetitive behaviour than industries with a churn rate above 1. *Graph 8* depicts that the higher the survival rate, the more industries are prone to anticompetitive behaviour. *Graph 9* illustrates that there is a, more or less, linear relationship with the R&D rate and the likelihood of anticompetitive behaviour in the case of R&D < 3000. R&D rates exceeding 3000 are considered not to indicate anticompetitive behaviour.



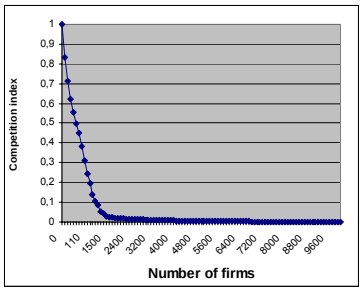

Graph 1 (0, ∞),(0,1)



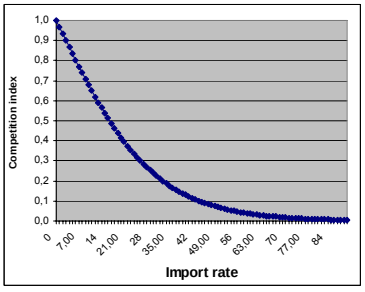

Graph 2 (-∞, ∞),(0,1)



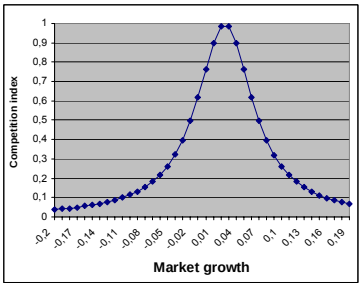

Graph 3 (0, ∞),(0,1),



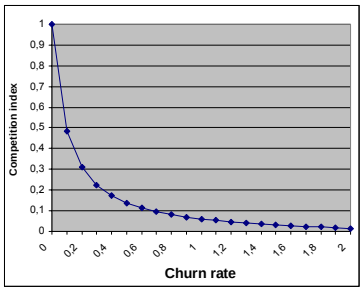

Graph 4 (0, ∞),(0,1)



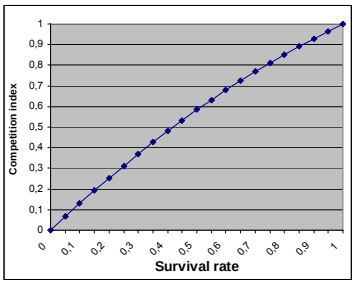

Graph 5 (0, ∞),(0,1)



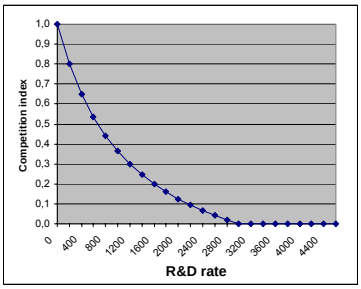

Graph 6 (-∞, ∞),(0,1)




Graph 7 (0, ∞) ,(0,1)




Graph 8 (0, 1),(0,1)



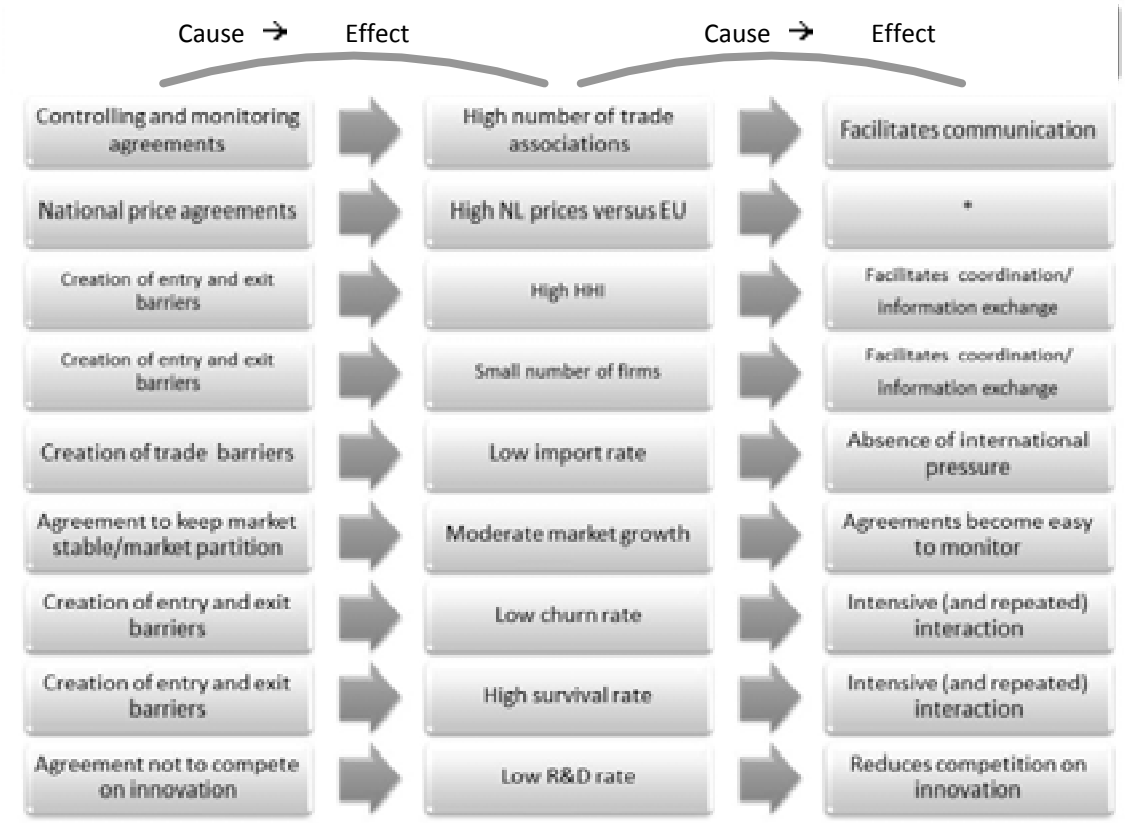

Graph 9 (0, ∞),(0,1)

### Target: Cause or effect?

There are two reasons why an industry might appear in the set of industries declared as "prone to anticompetitive behaviour". The first reason is that an industry indeed practices anticompetitive behaviour. The second reason is that an industry merely possesses certain characteristics that facilitate anticompetitive behaviour. In summary: the market situation according to the indicators can *cause* anticompetitive behaviour, or can be an *effect* of anticompetitive behaviour. Figure 3.2 elaborates on this reasoning. However, these two subsets cannot be distinguished without further investigation.

Figure 3.2 depicts how the anticompetitive behaviour, in the left column, may result in the market characteristics that we measure using the indicators (second column). In other words: the high or low value of the indicator is an *effect* of the anticompetitive behaviour. The third column describes how behaviour, which may be anticompetitive, is facilitated by the market characteristics measured by the indicators (i.e. where the high number of trade associations exists due to an exogenously determined market-structure, and therefore may *cause* anticompetitive practices). Of course, the behaviour in question may transpire not to be, in fact, anticompetitive. We cannot, as yet, distinguish the anti-competitive behaviour, from normal commercial practice. Nevertheless, the results of applying the indicators still deliver a set of industries "prone to anticompetitive behaviour" which captures interesting observations for a competition authority.

**Figure 3.2 Cartelization: Effect or Cause**




* There is no explanation about how high prices as such support cartelization.

## *3.4* Industry classification, data, descriptives and weightings

### Industry classification

For the purpose of our analysis, we have partitioned the Netherlands' economy into groups of comparable industries. For this industry classification we make use of the "BIK '95" layout. This is a hierarchical classification of all the industries of the Netherland's economy developed by the Netherlands Chamber of Commerce (KvK). It starts with 17 general sections marked with a character. These sections are separated into 2 digit industries, which are subsequently separated into 3, 4, 5 and maximum 6 digit industries. At the lowest (6 digit) level there are 1260 unique industries. Due to data restrictions and availability, our analysis is executed at a 4 digit level. A limitation of this industry classification is that it does not necessarily capture the relevant markets, in competition law terms. As mentioned in the previous section, there are indicators that can rectify slight faults in the relevant market specification. However, for screening purposes it is hard to correctly define each relevant market. Nevertheless, the BIK '95 layout captures 502 industries at the 4 digit level.

### Data sources and descriptives

In order to obtain data, we consulted three data sources. The main sources are the Netherlands Chamber of Commerce (KvK), and Statistics Netherlands (CBS). In addition, we collected data from the European Central Bank (ECB). Table 3.1 depicts the descriptive statistics. Statistics Netherlands provided data at a 3 digit level, the remaining data are at a 4 digit level. All the data are for the year 2008, except for the indicator, 'trade associations' which is for the year 2010.

Based on table 3.1, the data reveal relatively low levels of data for; prices, HHI, import rate, market growth and R&D rate (N is rather low). The remaining four indicators have a higher availability (N exceeds 381). Industries with a coverage rate exceeding 55% (i.e. a minimum data availability of at least five variables) are adopted in the analysis. A mere 23 industries do not satisfy this 55% data constraint. They show data for less than five variables (appendix 1 provides an overview of those excluded industries). The coverage ratios 56%, 67%, 78%, 89% and 100% represent respectively 77, 36, 111, 207 and 48 industries.

**Table 3.1 Descriptive statistics**

| Indicator | Source | N | Minimum | Maximum | Mean | Std. deviation |
|---|---|---|---|---|---|---|
| # Trade associations | KvK | 502 | 0,00 | 19 | 2,62 | 3,36 |
| Prices | ECB | 305 | 69 | 107 | 98 | 5,70 |
| HHI | CBS | 381 | 0,00 | 0,89 | 0,14 | 0,17 |
| # Firms | KvK | 501 | 1,00 | 302882 | 3212 | 15061 |
| Import rate | CBS | 365 | 0,00 | 91 | 31 | 27 |
| Market growth | CBS | 381 | -0,84 | 2,45 | 0,03 | 0,31 |
| Survival rate | KvK | 501 | 0,00 | 0,94 | 0,41 | 0,11 |
| Churn rate | KvK | 501 | 0,00 | 1,00 | 0,16 | 0,10 |
| R&D rate | CBS | 121 | 10 | 28957 | 2412 | 4398 |

## Weighting Schemes

In order to aggregate the standardized scores, three different weighting schemes are applied (see table 3.2). This results in three scores between 0 and 1 that provide an indication per industry about the likelihood of anticompetitive behaviour. The indicators are aggregated within the corresponding categories and the results are finally aggregated to a CI score.[12] The third column ('Method 1') of table 3.2 depicts the initial weighting scheme as used in Vermeulen (2007) and Buijs and Vermeulen (2008). In case the outcome was unduly dependent on the arbitrary distribution of these weights, we studied the sensitivity of the results by using two additional weighting schemes.

Firstly, we describe the initial weightings ('Method 1'). In 'Method 1',we considered concentration to be the most important aspect of competition. The concentration category was therefore allocated 40%. Dynamics is an important characteristic of competition as well, this category was allocated 30% in the Competition Index. The remaining two categories/indicators are of minor importance, yet necessary to adopt. Price index NL vs. EU and trade associations were both allocated 15% in the Competition Index in 'Method 1'. We already mentioned that the churn rate indicator and the survival rate indicator might overlap. Because of this similarity, the sum of weights of these two indicators together was the same (in 'Method 1 and 2') as the other single indicators in the dynamics category: each represented one third of the dynamics category.

[12] Regarding table 3, the data availability is not 100% for all industries. Hence, the weight of a missing variable is pro rata allocated among the other variables within the same category. In case of a missing category, the weight is pro rata allocated among the other categories (except for method 3, this method makes no distinction between the categories).

Initially the HHI had a high weighting coefficient (see the underlined number).[13] In an alternative method ('Method 2') we corrected for this weight and allocated it across the number of firms, the HHI and the import rate so that the weights became equally distributed (see the framed numbers). We chose to allocate the weight among those three indicators so that the concentration category remained 40% in the CI. The weighting coefficients of the other indicators remained unchanged in the second method. 'Method 3' applied naïve weighting figures, i.e. it used uniform weightings. It furthermore ignored predetermined allocation to the categories. Consequently, there was no need to justify the allocated weighting coefficients. It should be observed that the dynamics category was allocated 44% instead of the initial 30%. The concentration category, on the contrary, was allocated 33% instead of the initial 40%. Finally, the degree of organization and prices in Method 3 also had a lower importance. Section 5.1 elaborates on possible correlations between the indicators and the categories.

**Table 3.2 Weighting schemes (revision)**

| Indicator | Category | Method 1 | Method 2 | Method 3 |
|---|---|---|---|---|
| Number of trade associations | Degree of organization | 15% | 15% | 11% |
| Price index NL vs. EU | Prices | 15% | 15% | 11% |
| Number of firms | Concentration | 4% | 13% | 11% |
| HHI | Concentration | 32% | 13% | 11% |
| Import rate | Concentration | 4% | 13% | 11% |
| Churn rate | Dynamics | 5% | 5% | 11% |
| Survival rate | Dynamics | 5% | 5% | 11% |
| R&D rate | Dynamics | 10% | 10% | 11% |
| Market growth | Dynamics | 10% | 10% | 11% |

[13] In Vermeulen (2007) and Buijs and Vermeulen (2008) the C4 rate was used instead of the current HHI. Due to data issues, in this analysis, the C4 rate is replaced by the HHI.

# 4 Results

This section presents the results of the NMa's Competition Index. Table 4.1 provides an overview of the top 30 industries most prone to anticompetitive behaviour.[14] [15] The weight differences among the methods used result in three different ranking lists.

**Table 4.1 Top 30 industries "prone to anticompetitive behaviour"[16]**

| **Method 1** | CI | **Method 2** | **CI** | **Method 3** | **CI** |
|---|---|---|---|---|---|
| Manufacture of malt* | 0,84 | Manufacture of lime* | 0,83 | Manufacture of lime* | 0,82 |
| Manufacture of other non-distilled fermented beverages* | 0,83 | Manufacture of malt* | 0,81 | Manufacture of malt* | 0,80 |
| Manufacture of lime* | 0,83 | Manufacture of plaster* | 0,81 | Manufacture of other non-distilled fermented beverages* | 0,79 |
| Manufacture of basic iron and steel and of ferro-alloys | 0,81 | Manufacture of other non-distilled fermented beverages* | 0,80 | Manufacture of plaster* | 0,78 |
| Manufacture of plaster* | 0,80 | Processing of nuclear fuel* | 0,73 | Transport via pipelines* | 0,69 |
| Production of mineral waters and soft drinks* | 0,78 | Manufacture of cement* | 0,72 | Production of mineral waters and soft drinks* | 0,68 |
| Manufacture of beer* | 0,76 | Production of mineral waters and soft drinks* | 0,72 | Retreading and rebuilding of rubber tyres* | 0,67 |
| Air transport# | 0,74 | Transport via pipelines* | 0,71 | Youth hostels* | 0,66 |
| Transport via railways* | 0,73 | Youth hostels* | 0,70 | Manufacture of fibre cement articles# | 0,66 |
| Renting of water transport equipment (ship renting)* | 0,73 | Manufacture of basic iron and steel and of ferro-alloys* | 0,69 | Manufacture of cement* | 0,66 |
| Manufacture of television and radio receivers* | 0,73 | Retreading and rebuilding of rubber tyres* | 0,69 | Camping sites* | 0,65 |
| Processing of nuclear fuel* | 0,73 | Camping sites* | 0,68 | Processing of nuclear fuel* | 0,65 |
| Manufacture of steam generators* | 0,72 | Manufacture of steam generators* | 0,68 | Manufacture of rubber tyres and tubes* | 0,65 |
| Manufacture of cement* | 0,72 | Manufacture of coke oven products* | 0,67 | Manufacture of leather clothing* | 0,65 |
| Retreading and rebuilding of rubber tyres* | 0,72 | Manufacture of rubber tyres and tubes* | 0,67 | Production of ethyl alcohol from fermented materials* | 0,64 |
| National post activities* | 0,72 | Manufacture of beer* | 0,67 | Manufacture of basic iron and steel and of ferro-alloys * | 0,64 |

[14] For an extensive overview of all the industries see: http://www.nma.nl
[15] One might question why a ranking list is compiled, since section 3.2 stated that a ranking method is not optimal. However, the ranking list in table 4.1 has been adapted to take the argument in 3.2 into account. We state that a ranking list at indicator level is not useful. When every indicator has its own standardized value, comparability (and thus a ranking list) becomes convenient.
[16] Industries that appear in all of the three methods are flagged with an asterisk; industries that appear twice are flagged with a hash-sign.

| | | | | | |
|---|---|---|---|---|---|
| Manufacture of rubber tyres and tubes* | 0,71 | Manufacture of leather clothing* | 0,65 | Transport via railways* | 0,63 |
| Renting of air transport equipment (aircraft renting)* | 0,71 | Holiday homes# | 0,65 | Construction of water projects# | 0,63 |
| Transport via pipelines* | 0,71 | Manufacture of cider and other fruit wines* | 0,64 | Manufacture of beer* | 0,63 |
| Manufacture of rubber products* | 0,70 | Manufacture of fibre cement articles# | 0,64 | Manufacture of rubber products* | 0,62 |
| Manufacture of motor vehicles | 0,70 | Production of ethyl alcohol from fermented materials* | 0,64 | Manufacture of coke oven products* | 0,62 |
| Manufacture of railway and tramway locomotives and rolling stock* | 0,70 | Renting of water transport equipment (ship renting)* | 0,63 | Manufacture of ceramic insulators and insulating fittings* | 0,62 |
| Manufacture of cider and other fruit wines* | 0,69 | Manufacture of railway and tramway locomotives and rolling stock* | 0,63 | Manufacture of cider and other fruit wines* | 0,62 |
| Manufacture of ceramic insulators and insulating fittings* | 0,69 | Construction of water projects# | 0,62 | Holiday homes# | 0,61 |
| Repair of boots* | 0,68 | Hotels# | 0,62 | Manufacture of steam generators* | 0,60 |
| Manufacture of coke oven products* | 0,67 | Striking of coins* | 0,62 | Striking of coins * | 0,60 |
| Local post and courier activities | 0,67 | Salt production | 0,62 | National post activities* | 0,59 |
| Renting of passenger cars | 0,67 | Manufacture of rubber products* | 0,61 | Repair of boots* | 0,59 |
| Production of ethyl alcohol from fermented materials* | 0,67 | Manufacture of ceramic insulators and insulating fittings* | 0,61 | Manufacture of musical instruments | 0,59 |
| Manufacture of footwear | 0,66 | Renting of air transport equipment (aircraft renting)* | 0,61 | Hotels# | 0,58 |

Table 4.2 presents an overview of the industries found to be “prone to anticompetitive behaviour”. Once an industry is in the top 30 of table 4.1, according to all three methods, it is listed in table 4.2. Additionally, table 4.2 visualizes the dominance of individual indicators, as regards the CI results, by showing the standardized scores. In line with the descriptive statistics, the data on prices, HHI, import, market growth and R&D are relatively scarce, whereas the data for the number of organizations, survival rate and churn are commonly available. Manufacturing industries represent a significant part of the list. This is largely due to the high number of trade associations in these industries. Another interesting observation is that the results under ‘number of firms’ often approaches one (indicating possible oligopoly). Import rates, on the other hand, are generally not generating results that might indicate anticompetitive behaviour under the Competition Index. In addition, it appears that transport industries and the renting of transportation equipment are concentrated; the standardized HHI score is one in these industries.

## Table 4.2 Characteristics of industries "prone to anticompetitive behaviour"

| Industry | # Trade ass. | Prices NL vs EU | HHI | # Firms | Import rate | Market growth | Surv. rate | Churn rate | R&D rate |
|---|---|---|---|---|---|---|---|---|---|
| Manufacture of malt | 1,0 | 1,0 | 0,7 | 0,9 | 0,1 | 1,0 | 0,7 | 1,0 | |
| Manufacture of other non-distilled fermented beverages | 1,0 | 1,0 | 0,7 | 1,0 | 0,1 | 1,0 | 0,6 | 1,0 | |
| Manufacture of lime | 1,0 | 1,0 | | 0,9 | | | 0,9 | 1,0 | 0,1 |
| Manufacture of basic iron and steel and of ferro-alloys | 0,9 | | 1,0 | 0,3 | | 0,8 | 0,5 | 0,3 | 0,6 |
| Manufacture of plaster | 0,9 | | 1,0 | 0,3 | | 0,8 | 0,5 | 0,3 | 0,6 |
| Production of mineral waters and soft drinks | 1,0 | 1,0 | 0,7 | 0,6 | 0,1 | 1,0 | 0,7 | 0,4 | |
| Manufacture of beer | 1,0 | 1,0 | 0,7 | 0,3 | 0,1 | 1,0 | 0,5 | 0,4 | |
| Transport via railways | 1,0 | 0,0 | 1,0 | 0,2 | | 0,6 | 1,0 | 0,7 | |
| Renting of water transport equipment (ship renting) | 0,8 | 1,0 | 1,0 | 0,2 | 0,7 | 0,1 | 0,4 | 0,3 | 0,6 |
| Manufacture of television and radio receivers | 1,0 | 1,0 | 1,0 | 0,2 | | 0,0 | 0,5 | 0,4 | |
| Processing of nuclear fuel | 0,0 | | | 0,9 | | | 0,4 | 1,0 | 0,9 |
| Manufacture of steam generators | 0,8 | | 1,0 | 0,7 | | 0,0 | 0,5 | 0,6 | 0,5 |
| Manufacture of cement | 1,0 | 1,0 | | 0,8 | | | 0,6 | 0,5 | 0,1 |
| Retreading and rebuilding of rubber tyres | 1,0 | | 0,6 | 0,8 | 0,0 | 1,0 | 0,5 | 0,5 | 0,9 |
| National post activities | 0,6 | 1,0 | 1,0 | 0,1 | 0,7 | 0,7 | 0,8 | 0,5 | 0,0 |
| Manufacture of rubber tyres and tubes | 1,0 | | 0,6 | 0,8 | 0,0 | 1,0 | 0,5 | 0,4 | 0,9 |
| Renting of air transport equipment (aircraft renting) | 0,6 | 1,0 | 1,0 | 0,2 | 0,7 | 0,1 | 0,5 | 0,3 | 0,6 |
| Transport via pipelines | 0,8 | | | 0,6 | 1,0 | | 0,7 | 0,4 | |
| Manufacture of rubber products | 1,0 | | 0,6 | 0,3 | 0,0 | 1,0 | 0,6 | 0,6 | 0,9 |
| Manufacture of railway and tramway locomotives and rolling stock | 0,9 | | 1,0 | 0,6 | | 0,1 | 0,6 | 0,3 | |
| Manufacture of cider and other fruit wines | 1,0 | 0,4 | 0,7 | 0,8 | 0,1 | 1,0 | 0,6 | 0,4 | |
| Manufacture of ceramic insulators and insulating fittings | 0,9 | | 0,9 | 0,9 | 0,2 | 0,1 | 0,3 | 1,0 | |
| Repair of boots | 0,6 | 1,0 | 1,0 | 0,0 | 1,0 | 0,0 | 0,5 | 0,5 | |
| Manufacture of coke oven products | 0,0 | | | 0,9 | | | 0,7 | 1,0 | 0,4 |
| Production of ethyl alcohol from fermented materials | 1,0 | 0,0 | 0,7 | 0,9 | 0,1 | 1,0 | 0,5 | 1,0 | |

# 5 Analysis and applicability

The objective of the Competition Index is to detect industries prone to anticompetitive behaviour. However, the exact size and location of actual anticompetitive practices is unknown. As a result, verification of the Competition Index is difficult. Nevertheless, this section attempts to test the CI methodology on its robustness, using three checks; an internal check, an external check and finally by an empirical check.

## *5.1* Internal check

### Weighting Schemes

Three different weighting schemes were applied to aggregate the standardized scores of the indicators into one CI score (see table 3.2). In order to test the relative importance of the allocated weights, a correlation analysis is convenient.

Since it is not the scores that we obtain from the CI that are useful, but rather the ranking list that follows from those results, a "Spearman Rank Correlation" test is performed. This test focuses on the correlation between the different ranking lists that stem from the different CI scores per individual weighting scheme. The three ranking lists resulting from the three weighting schemes deliver strong and significant correlation coefficients. The correlations between methods 1 and 2, methods 1 and 3 and methods 2 and 3 are respectively 0,89, 0,86 and 0,94.[17] Hence, we can conclude that the weighting differences do not significantly influence the outcomes.

### Analysis of the (standardized) indicators

For an industry, to obtain a CI score of one, every single indicator should point at a high likelihood of anticompetitive behaviour. The existence of anticompetitive behaviour is obviously not dependent upon all variables being high (i.e. a standardized score of one for each indicator is not essential). However, the more variables that approach a score of one, the higher the likelihood of anticompetitive behaviour. Table 5.1 presents the bivariate correlations among the individual standardized indicators. Based on these results, it is tempting to conclude that the standardized variables are not sufficiently robust: the

[17] The correlations are significant at the level of 1%. Industries with data availability exceeding 44% were used in this analysis.

correlations show ambiguous results. However, we would not expect to find merely positive and significant correlations. It is highly likely to be the case that some standardized scores in an "average market" do not match.[18] In fact, these ambiguous correlation results imply that all the individual indicators really do add information.

**Table 5.1 Correlations individual standardized indicators**

| | # Trade ass. | Prices | HHI | # Firms | Import rate | Market growth | Survival rate | Churn rate |
|---|---|---|---|---|---|---|---|---|
| **Prices** | ,063 | | | | | | | |
| **HHI** | -,048 | ,068 | | | | | | |
| **# Firms** | -,207** | -,018 | ,329** | | | | | |
| **Import rate** | ,042 | -,007 | -,196** | -,555** | | | | |
| **Market growth** | ,115* | ,129 | -,282** | -,091 | -,078 | | | |
| **Survival rate** | ,027 | -,046 | ,055 | ,085 | -,204** | ,128* | | |
| **Churn rate** | -,063 | -,038 | ,216** | ,496** | -,353** | ,012 | ,256** | |
| **R&D rate** | ,028 | -,271* | -,074 | -,237** | ,365** | ,380 | -,150 | -,190* |

** Significant at the level of 0,01 (2 tailed)
* Significant at the level of 0,05 (2 tailed)

In addition, it is interesting to see to what extent the four categories correlate. At category level, the correlations appear to be rather low. The highest (significant) correlation of -0,19 is between the degree of organization and concentration (according to 'Method 2'). Concentration (according to 'Method 1') and degree of organization have a correlation coefficient of -0,15. Another significant correlation is between concentration and dynamics (-0,10).[19]

Furthermore, it is interesting to see to what extent high sub-scores occur together within an industry. Let us define a standardized score of 0,8 and higher as "extreme" and let us say that at least five of the indicators have to be qualified as "extreme". Under that restriction we find merely three industries that meet the criteria: manufacture of malt, manufacture of other non-distilled fermented beverages and manufacture of lime. Once we relax the restriction to a minimum of four extreme indicators we can add: manufacture of distilled potable alcoholic beverages, retreading and rebuilding of rubber tyres, manufacture of ceramic insulators and insulating fittings, manufacture of plaster, manufacture of fibre cement articles, manufacture of other general purpose machinery incl. their parts n.e.c., hotels and camping sites.

[18] E.g. various studies find evidence that a competitive market with many organizations does not trigger R&D investments (Aghion *et al.*, 2005).
[19] The correlations are significant at the level of 5%.

## *5.2* External check

### Refused exemption requests

This section attempts to test the accuracy of the CI by checking for a link between the CI output and the requests for exemption from the cartel prohibition, which were refused by the Netherlands Competition Authority from 1998 to 2004. The NMa was established in 1998, from that time, until the abolition of the notification system in 2004, firms were obliged to report their agreements to the NMa. The NMa examined whether the agreements were in conflict with article 6 (Mw) regarding anticompetitive agreements.[20] The dataset used, contains requests from 1998 until 2004. Agreements conflicting with article 6 (Mw) have been classified as a "refused exemption request" (RER). After the refusal, the agreements were assumed to be discontinued, this category counts 168 requests.

The refused exemption requests were generally registered at a 4 digit BIK level. Incidentally the RER was reported at a 3 digit level, there were presumably several 4 digit industries involved. The comparison between the refused exemption requests and the CI outcome were conducted according to the following rules:

1) Where there was at least one RER in the industry, the industry is marked with a "1", i.e. we apply a dummy in the event of one or more RER's. We do not distinguish between the number of RER's.
2) Where an RER was at a 4 digit level, a dummy is generated for that specific 4 digit industry. Where an exemption request was at a 3 digit level, a dummy is generated for all its 4 digit industries (except for those that were already marked at a 4 digit level).

It should be mentioned that we are well aware of the fact that this data-set does not cover all anticompetitive behaviour and thus acknowledge the risk of a sample selection bias. Besides, the time gap between the RER's and the CI outcomes is distortive of the results. Nevertheless, we expect that the subset of industries with at least one RER has higher CI scores than the subset without RER's. Table 5.2 depicts the output of the independent sample t-test for the three weighting schemes. It appears that the mean CI score (for

[20] Article 6 (Mw) is comparable to article 101 (TFEU) which prohibits anticompetitive agreements.

method 3) for the subset of industries with RER's is significantly higher than the mean CI score for the subset which has no RER's. The other methods lack significance at a 95% confidence level.[21]

**Table 5.2 Independent sample t-test[22]**

| Method | RER set | N | Mean | Significance |
|---|---|---|---|---|
| 1 | No RER | 362 | 0,385 | 0,276 |
| | ≥1 RER | 117 | 0,402 | 0,272 |
| 2 | No RER | 362 | 0,396 | 0,144 |
| | ≥1 RER | 117 | 0,415 | 0,147 |
| 3 | No RER | 362 | 0,407 | 0,026* |
| | ≥1 RER | 117 | 0,432 | 0,027* |

* Significant at the level of 0,05 (2 tailed)

Based on these results we can tentatively state that the CI scores show a relation with rejected exemption requests from the past regarding method 3. According to this method it seems that sectors with the presence of at least one blocked exemption request in the past are attended by higher CI scores.

### Antitrust issues worldwide

This section attempts to explore a possible link between real cases of anticompetitive conduct occurring at various markets all over the world, and some of the industries that show themselves to be "prone to collusion" according to our application of the CI (table 4.2). It is essential to note that the existence of overlap, or the absence of overlap provides neither resounding proof nor rejection of the CI methodology. To take an example; The cement industry in The Netherlands scored highly on the CI. When we look at worldwide trends, we can observe that the cement industry worldwide seems to show a high prevalence of cartels. There have been cartels in this industry (or at least restrictions of competition) in the EU, Denmark, Germany, Argentina, Romania, Taiwan, Turkey, France, Egypt, India, Poland and Pakistan (Anand, 2009). In December 2010 antitrust proceedings were opened by the European Commission against several cement manufacturers. To take some other examples of sectors that scored highly on the CI:

[21] Considering the special nature of the healthcare sectors, the problematic market definitions and the nature of the RER's in these sectors (many intended agreements were vertically) we also executed this analysis for all the industries excluding the healthcare sectors. With this restriction, the independent sample t-test generates more significant outcomes. Method 2 and method 3 generate a significant higher mean in the subset with RER's at a 95% confidence level.

[22] Industries with data availability exceeding 44% were adopted in this analysis.

- We observe that companies in Denmark in the construction sector were also fined for anticompetitive behaviour in 2010.
- In Germany a fine was imposed on two manufacturers of steam boilers (August 2010). The firms entered into agreements on consumer allocation, quantity and prices.
- Transport via pipelines (and specifically its access) was also subject of research of the European Commission in Germany and Norway. In 2006 five synthetic rubber producers were fined by the European Commission.
- In NERA (2004) processing of nuclear fuel is ranked number one in their model showing a likelihood of anti-competitive issues.
- Grout & Sonderegger (2005) estimate a 44% probability that manufacturers of railway are involved in cartel activity.

This list just gives a flavour of possible links. Obviously if one searches long enough, every sector becomes suspicious. Nevertheless, these examples simply serve to give an impression of possible similarities that may emerge from a worldwide analysis, were such an exercise possible.

### *5.3* **Empirical check**

The "empirical check" is the final attempt in this paper to assess the CI methodology. In this part the CI scores are compared with data on productivity and data on inefficiency. Two measurements, also depicted in table 2.1, are adopted in this analysis: the labour productivity (given the positive relationship between competition and productivity [23] [24]), (Lorenz, 2008) and the level of wage cost (as an indicator for possible inefficiencies), (Grout and Sonderegger, 2005). A competitive market should be attended by high labour productivity and therefore a low CI score (see expected sign in table 5.3). Secondly, high wage costs can signal inefficiency, and therefore a high CI score is expected in an industry where wage costs are high (see expected sign in table 5.3). The descriptive statistics are enclosed in appendix 2. Table 5.3 depicts the correlations between those empirical indicators and the CI scores.

[23] See, for instance, Ospina and Schiffbauer (2010).
[24] Data source: CBS, year: 2008. The 4 digit CI scores are linked to the indicators at a 3 digit level. For the labour productivity and wage costs we were able to link them to 381 4 digit industries.

**Table 5.3 CI scores vs. competition indicators[25]**

| | Exp. sign | CI Method 1 | CI Method 2 | CI Method 3 |
|---|---|---|---|---|
| Lb. productivity | - | -0,200** | -0,128* | -0,117* |
| Wage cost | + | 0,140** | 0,004 | 0,021 |

** Significant at the level of 0,01 (2 tailed)
* Significant at the level of 0,05 (2 tailed)

Four of the six correlations result in significant correlations. There are signals that labour productivity is positively related with the CI scores. Although there is one significant correlation with wage cost, the other two show the expected positive or negative sign. Based on these results we can tentatively state that a lower CI score is (to some extent) attended with higher labour productivity. Also, for CI method 1 we can state that a higher CI score is (to some extent) attended with higher wage costs.

## *5.4* Conclusion

This section was a first attempt to test the CI methodology. A sensitivity check shows us that the results are rather robust when we apply alternative weighting schemes. Secondly, it seems that refused exemption requests from the past may be indicative for current CI results when we apply weighting method 3. Finally, a correlation analysis shows us that there is a negative relationship between the labour productivity and the CI results, as predicted. Yet, one should keep in mind that more extensive research is recommended to draw more solid and accurate conclusions.

[25] Industries with data availability exceeding 44% were adopted in this analysis.

# 6 Concluding remarks

1) This paper describes the Competition Index (CI) as developed by the Netherlands Competition Authority (NMa). The CI is a pro-active approach to detect markets that may be prone to anticompetitive behaviour. The CI is based on nine indicators. By applying (three) weighting schemes, the standardized values of the indicators are aggregated to a CI score. A score of "1" indicates a high likelihood of anticompetitive behaviour, while a score of "0" excludes this likelihood under this methodology.

2) A ranking list for all 500 industries of the Netherlands' economy is compiled based on this methodology. Section 4 presented the top 30 industries that were found to be "prone to anticompetitive behaviour". Section 5 attempted to test the methodology by executing various tests and checks. Weighting schemes appeared not to significantly influence the results. Furthermore, it seems that evidence of refused exemption requests in the past may be indicative for the current CI scores. Some sectors that were found to be "prone to anticompetitive behaviour" seem also to attract the attention of competition authorities in other jurisdictions, for example, the cement sector.

3) Little is known about similar approaches that may be utilized by other competition authorities. Often a bottom-up approach is used (i.e. price screens). The key advantage of our methodology compared to other studies is that the entire economy is subject to scrutiny. There are several reasons why the CI is useful. First of all, because of the deterrence and destabilizing effect of the ranking on cartelization. Secondly it can provide new insights. In combination with other supporting indirect evidence, such as signals and complaints this CI methodology can have a significant added value. In the end, our CI serves merely as an assistance for detecting (possible) anticompetitive behaviour. The CI can serve as a warning to the authority, that a specific industry with a high score may be worth an in-depth review. In the following points we discuss some limitations of the methodology and suggestions for future research.

4) How should we deal with the so called "everlasting subset" in future analyses? Some industries will permanently appear high on the ranking list. This could be due to their exogenously determined structure. It would be recommendable to find a way to identify

those “everlastings” so we could also focus on industries that are “new” in this high-score subset.

5) In future analyses, we would like to have more data at a more detailed industry-level. Considering the number of studies that focus on the volatility of prices, it might be an idea to incorporate this variable in the methodology. One of the criticisms of the CI is that the demand side of the market is not incorporated in the analysis, although the demand side is rather a crucial aspect of competition. One possible demand side indicator that summarizes the degree of competition is the price elasticity of demand. The price elasticity captures the willingness and possibility of consumers to discipline prices. Furthermore, it may be useful to study whether other methodologies (e.g. a filter approach where industries are excluded step by step) generate significant other or better outcomes. In addition, it would be helpful to design a verification method that also uses economic insights.

## References


Andeweg, A.M., G.J.C.M. Bakker and C.M. van den Broek (2009), Toezichtconjunctuur, in: P. Kalbfleisch, E.G.A. Lamboo, J. van Sinderen and R. Smits (ed.), De blijvende uitdaging, Liber Amicorum for G.J.L. Zijl and R.J.P. Jansen, The Hague: NMa pp. 111-128.

Anand, S. (2009), Identifying cartels using econometric evidence: a case study of Indian cement industry, Competition Commission of India.

Abrantes-Metz, R. M., L.M. Froeb, J. Geweke and C.T. Taylor (2006), A Variance Screen for Collusion, International Journal of Industrial Organization, 24, pp. 467-486.

Abrantes-Metz, R. M. and P. Bajari (2009), Screens for Conspiracies And Their Multiple Applications, Antitrust, 24 (1), pp. 66-71.

Aghion, P., N. Bloom, R. Blundell, R. Griffith and P. Howitt (2005), Competition and Innovation: An Inverted-U Relationship, Quarterly Journal of Economics, 120(2), pp. 701-728.

Bajari, P and L. Ye (2003), Deciding Between Competition and Collusion, The Review of Economics and Statistics, 85 (4), pp. 971-989.

Banisar, D. (2006), Whistleblowing: International Standards and developments, Paper presented at the Primera Conferencia International Sobre Corruption y Transparencia, Ciudad de Mexico.

Blanckenburg, K.v. and A. Geist (2009), How Can a Cartel be Detected? International Advances in Economic Research, 15(4), pp. 421-436.

Bolotova, Y., J. M. Connor and D. J. Miller (2008), The Impact of Collusion on Price Behavior: Empirical Results from Two Recent Cases, International Journal of Industrial Organization, 26, pp. 1290-1307.

Brenner, S. (2009), An empirical study of the European corporate leniency program, International Journal of Industrial Organization, 27 (6), pp. 639–645.

Buijs, M.A.D. (2009), Economische detectie door de NMa, Economisch Statistische Berichten, 94(4566), pp. 493–494.

Buijs, M.A.D. and T.C. Vermeulen (2008), Detectie van mededingingsbeperkend gedrag. Onderzoeksrapport economische detectiemethoden, NMa discussion papers 2008(1).

Combe, E., C. Monnier and R. Legal (2008), Cartels: the Probability of Getting Caught in the European Union, BEER working paper 12.

Cramton, P. and J.A. Schwartz (2002), Collusive Bidding in the FCC Spectrum Auctions, Contributions to Economic Analysis & Policy, 1 (1).

Grout, P.A. and S. Sonderegger (2005), Predicting Cartels, Office of Fair Trading, Economic discussion paper 773.

Harrington Jr, J.E. (2006), Behavioral screening and the detection of cartels, in: European Competition Law Annual 2006: Enforcement of Prohibition of Cartels, Hart Publishing, 2007.

Høj, J. (2007), Competition Law and Policy Indicators for the OECD countries, OECD Economics Department Working Papers 568.

Hüschelrath, K. (2010), How Are Cartels Detected? The Increasing Use of Proactive Methods to Establish Antitrust Infringements, Journal of European Competition Law & Practice, 1 (6), pp. 522-528.

Levenstein, M.C. and V.Y. Suslow (2006), What Determines Cartel Success? Journal of Economic Literature, 44 (1), pp. 43-95.

Lorenz, Ch. (2008), Screening markets for cartel detection: collusive marker in the CFD cartel-audit, European Journal of Law and Economics, 26 (2), pp. 213-232.

Martin, S. (2001), Industrial Organisation. A European Perspective, Oxford University Press.

Motta, M. (2004), Competition Policy: Theory and Practice, Cambridge University Press.

Nader, R., P.J. Petkas and K. Blackwell (1972), Whistle blowing: the report of the conference on professional responsibility, New York: Grossman.

National Economic Research Associates (2004), Empirical indicators for market investigations, Office of Fair Trading, Economic discussion paper 749.

Ospina, S. and M. Schiffbauer (2010), Competition and Firm Productivity: Evidence from Firm Level Data, IMF working papers.

Petit, L.T.D. and J. van Sinderen (2011), Detectie van concurrentiegebrek in 2011, Economisch Statistische Berichten, 96(4604), pp. 118-121.

Porter, R.H. (2005), Detecting Collusion. Review of Industrial Organization, 26 (2), pp. 147-167.

Porter, R.H. and J.D. Zona (1997), Ohio School Milk Markets: An Analysis of Bidding, NBER Working Paper 6037.

Ragin, C.C. (2000), Fuzzy-set social science, University of Chicago Press.

Rey, P. (2006), On the Use of Economic Analysis in Cartel Detection, in: European Competition Law Annual 2006: Enforcement of Prohibition of Cartels, Hart publishing.

Schinkel, M.P. (2010), Market oversight games, Inaugural speech, University of Amsterdam, October 2010.

Symeonidis, G. (2003), In which industries is collusion more likely? Evidence from the UK, The Journal of Industrial Economics, 51(1), pp. 45-74.

Van Sinderen, J. and G.J.C.M. Bakker (2010), Deregulation, regulatory reform and the effectiveness of enforcement policies by competition authorities, Paper presented at the International Academic Conference on Economic and Social Development, Moscow, 6-8 April 2010.

Vermeulen, T.C. (2007), Detecting Collusion: The Cartel Index applied to the Dutch economy, Master-thesis study, Erasmus University Rotterdam.

# Appendices

**Appendix 1**: List of excluded industries

| BIK | Industry |
|---|---|
| 0122 | Breeding and farming of sheep |
| 0130 | Mixed farming |
| 0142 | Animal husbandry service activities |
| 0150 | Hunting |
| 0200 | Forestry and forestry services |
| 2960 | Manufacture of weapons and ammunition |
| 3140 | Manufacture of accumulators |
| 3710 | Recycling of metal waste and scrap |
| 7031 | Real estate agencies |
| 7032 | Management of real estate, fee/contract |
| 7511 | General public service activities |
| 7513 | Regulation/contribution, operation busin |
| 7522 | Defence activities |
| 7523 | Justice and judicial activities |
| 7524 | Public security |
| 7525 | Fire service activities (fire brigade) |
| 9111 | Business and employers organizations |
| 9112 | Activities of professional organizations |
| 9120 | Activities of trade unions |
| 9131 | Philosophical organizations |
| 9132 | Political organizations |
| 9500 | Private households with employed persons |
| 9900 | Extra-territorial organizations / bodies |

**Appendix 2**: Descriptive Statistics of labour productivity and wage costs

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Labour productivity | 381 | -327 | 2028 | 149 | 316 |
| Wage Costs | 381 | 8,69 | 135,51 | 40,74 | 13,07 |

Source: CBS

Nederlandse Mededingingsautoriteit