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Measuring competition in the Netherlands

A comparison of indicators over the period 1993-2001

In the 1990s policy makers took various measures to stimulate competition. This memorandum investigates the question in which direction competition in the Dutch market sector has changed. Four competition indicators are used. These indicators are derived from a database of 87 000 firms as well as from the input-output tables of the National Accounts. Data availability limits the analysis to the period 1993-2001. Remarkably, the indicators do not suggest that competition increased economy-wide. All show that competition changes have been rather small in many industries, but a considerable number of industries experience a sharp rise or strong fall in competition. Nonetheless, the indicators frequently contradict each other on the change in competition at the industry level. These differences can partly be traced back to differences in their economic concepts. In theory, the indicators can differ, because they respond differently to a reallocation of output from inefficient to efficient firms. Econometric and statistical tests provide some but mainly insignificant evidence to support this hypothesis.

Key words: competition, measurement, competition policy

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1 Introduction¹

Problem

This memorandum explores several competition indicators to get an impression how competition in the Netherlands developed over time at different levels of aggregation.

The intensity of competition is important for productivity and economic growth. Competitive pressure stimulates firms to operate efficiently by, for instance, ‘cutting the fat out’ of their organizations. It also brings prices in line with marginal costs, lowering the rents of producers and increasing consumer surplus. Vigorous competition may therefore result in more productivity as resources and output are allocated to their most productive use. Competition also stimulates firms to innovate, which enhances productivity and economic growth. However, if competition has become too intense in order to make innovation profitable, firms may abstain from innovation.

Policy makers took various measures to raise competitive pressure in product markets during the 1990s and early 2000s. International examples are the removal of the barriers to the internal markets of the European Union (EU) in 1992, the policy agenda set by the Lisbon European Council in 2000 and WTO-agreements. On top of that, Dutch policy makers renewed the Competition Act (‘Mededingingswet’ 1998). They also reformed regulations in the so-called MDW-operation to stimulate more competition in specific industries, and they privatised sectors like the telecom sector.

So far, the development of competition in the Netherlands since the early 1990s has hardly been investigated at an economy-wide scale. Despite policy interest and some illustrative studies², a clear overall view on whether or not competition has become fiercer and why, is still an unsettled research topic.

Question

This lack of information forms the key question of this memorandum:

How has competition changed across Dutch industries between 1993 and 2001?

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² See e.g. Felsö et al. (2001), and Lever and Nieuwenhuijsen (1998).

To answer this question, we explore and assess four different types of competition indicators. In that respect, this memorandum employs two novelties. The first novelty is that we use a new measure of competition – the relative profits measure – launched by Boone (2000). Besides this new measure, we employ three other measures of competition. These are the price-cost margin, a concentration index (i.e. the Herfindahl index) and the labour-income ratio.

The second novelty of this memorandum is the exploration of a comprehensive firm-level database of 87 000 firms in the Netherlands across almost 120 industries, covering large parts of the Dutch market sector including industries of the manufacturing industry, construction, trade, transport and commercial services sector. Data availability limits the analysis to the period 1993-2001. Besides firm-level data, we use National Account data from Statistics Netherlands as another source for measuring competition indicators. Using an integrating framework, the figures of the National Accounts come from various aggregated micro level sources. These aggregated figures reflect methods and procedures applied to integrate different sources. The results can differ from weighted aggregates from one particular source.

The theoretical part of this memorandum defines and discusses the economic concepts of the four competition indicators. It focuses on conceptual differences between the selected indicators and differences between micro data and industry level data.

The empirical part of this memorandum shows the results for all the indicators at two different levels of aggregation. First, it presents the findings for the Dutch market sector as a whole during 1993-2001. Here, we come across the issue on how to aggregate indicators across industries to provide an overall impression at an aggregated level. Whether or not industries compete with each other determines how to aggregate the detailed results. The empirical part also illustrates the competition results at the industry level. Additionally, it analyses opposite findings between indicators with regard to differences in economic concepts.

Structure

The remainder of the memorandum is structured as follows. The next section introduces the four competition indicators. It discusses which types of data are needed to calculate the indicators in practice and which data sources are used in this memorandum. Section 3 compares the indicators from a theoretical point of view and it mentions main measurement issues. Next, we present the competition results at different levels of aggregation. Section 5 investigates whether the three competition indicators derived from firm-level data match pairs wise and triple wise at the industry level. Section 6 proceeds on this issue and tests several explanatory variables that might explain differences between the competition indicators based on firm-level data. Finally, section 7 presents the main conclusions, sets a few challenges for further economic research and derives several implications for policy makers.

2 Competition indicators: measurement and data

This memorandum uses four indicators for measuring competition and two data sources. The indicators are the relative profits measure, the Herfindahl index, the price-cost margin and the labour-income ratio. The first three indicators are derived from a database of 87 000 firms, the latter from the input-output tables of the National Accounts. This data source also allows calculating the price-cost margin. Hence, for the latter competition measure, we have two observations, and in totality, we analyse five indicators. Data availability limits the analysis to the period 1993-2001.

2.1 Introduction

To answer the question how competition has developed since the 1990s, one should know what competition is and how to measure it. These questions are difficult to resolve, as competition is a complex phenomenon and the way to measure competition is still an unsettled topic in the literature. We regard product market competition as the game between firms on product markets in order to maximise their profits. This game is complex as many determinants are involved. For instance, firms' behaviour and their strategic interaction as well as external determinants like demand, number of competitors and the prevailing regulation determine the firms' output and prices.

It is difficult to capture all this kind of information on competition in a single figure. Still, researchers in the Industrial Organisation literature suggest measuring competition by using (indirect) indicators.³ Following this suggestion, this memorandum applies four indicators of competition. In fact, the indicators are the relative profits measure, the price-cost margin, the labour-income ratio and the Herfindahl index as a concentration ratio. The former is a new way to measure competition based on firm's profits. Other indicators of competition are possible as well but not applicable to the datasets used in this memorandum and those indicators focus on one particular aspect of competition (see box). To be precise, we employ two available data sources, viz. a firm-level database and the National Accounts. Both sources stem from Statistics Netherlands. The firm-level database is a new instrument for measuring the competition indicators.

The structure of this section is as follows. Section 2.2 introduces the four competition indicators and discusses which data are required to estimate these indicators. Section 2.3 discusses both data sources. Section 2.4 summarizes the main conclusions.

³ See e.g. Cabral (2000) and for a further elaboration Boone (2000).

Other competition indicators have limited focus

Other indicators could be used to measure the intensity of competition at the firm level as well, for example, import penetration and firm demography. However, these indicators focus on limited aspects of competition

Import penetration signals the intensity of global competition, or more precisely the contribution of foreign firms to competition in a domestic market. MacDonald points out that for highly concentrated US manufacturing industries, increases in import penetration had a strong impact on the productivity growth between 1975 and 1987 (see MacDonald, 1994). This suggests that "... growing international rivalry can impose new competitive pressure on firms that were previously insulated from competition...".

The changes in entry and exit (denoted as firm demography) can also be considered as competition indicators. Ahn argues that "... dynamic competition incessantly weeds out less efficient firms from more efficient ones and reallocates productive resources from shrinking/exiting firms to entering/growing firms..." (see Ahn, 2002). Many studies investigate the impact of firm demography on productivity growth (see Ahn, 2001, for an overview).

The drawback of these indicators is that they only focus on one aspect of competition but these indicators neglect other elements. These specific indicators can be considered as one of the determinants of competition. Import penetration focuses on trade issues. Entry and exit affects competition, still competition can change without entry and exit.

2.2 Four competition indicators

2.2.1 Relative profits measure

Boone recently developed a new way to measure competition (see Boone, 2000): the relative profits measure. The idea behind this measure is that fiercer competition leads to (relatively) more profits of the high-productive firms at the expense of the low-productive firms. Put differently, in a more competitive market firms are hurt more severely for being inefficient. The indicator rests on the approach that firms in an industry differ in their marginal costs, or stated otherwise, in their productivity level as the latter is inversely related to marginal costs. Fiercer competition can be observed by a steeper slope of the relation between relative profits of the firms and their relative levels of productivity.

Illustration mechanism relative profits measure

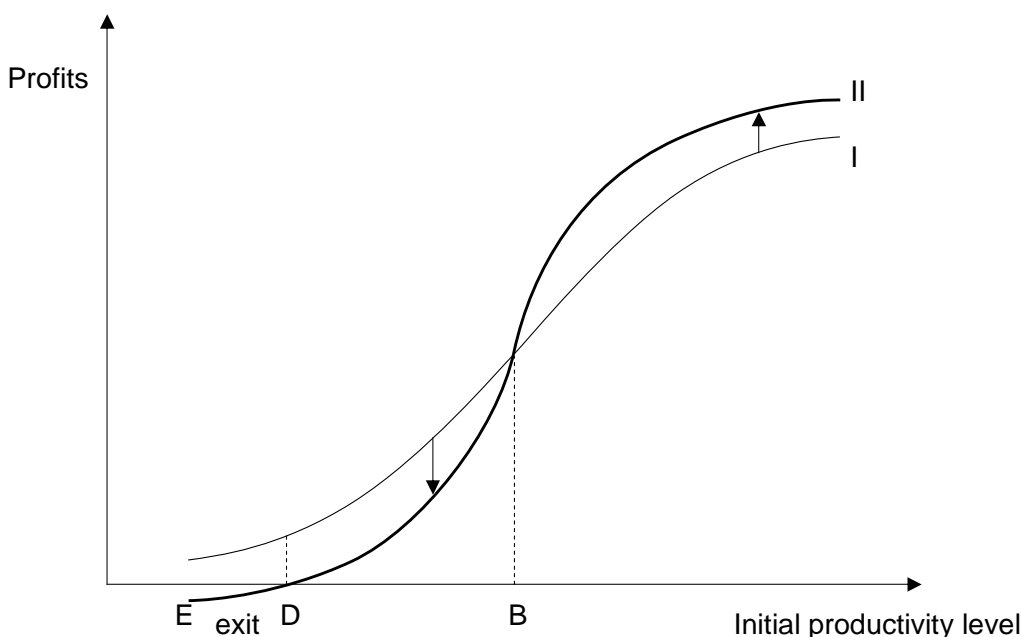
Figure 2.1 illustrates the general mechanism when competition changes. The horizontal axis ranks the firms according to their efficiency from high to low marginal costs or from low to high in terms of productivity level.

Line I of figure 2.1 shows the profit-productivity curve, which is the relation between the profits of a firm and its productivity level at the initial level of competition. The line slopes

upward, which implies that efficient firms earn more profits than less efficient firms do.⁴ The slope of the curve indicates the extent of competition.

Now assume that competition intensifies because of an exogenous shock. Increasing the competitive pressure induces the highly efficient firms (i.e. firms with an efficiency greater than B) to exploit their efficiency advantage more. Therefore, they push aside the less efficient firms (firms with efficiency lower than B). Consequently, they earn relatively more profits at the expense of the low efficient firms (i.e. reallocation in profits). Firms with a productivity level lower than D even start to make losses, and they exit (i.e. selection effect). As a result, the profit-productivity line rotates counter-clockwise. Hence, an increase in competition is shown by an increase in the average slope from profit-productivity curve I to profit-productivity curve II.

Figure 2.1 Product-productivity curves of non-interacting firms



Measurement relative profits measure

We estimate the relative profits measure by the (negative) relation between firm's profit and its marginal costs. As data on marginal costs are not directly observable, we use the average

⁴ The reasoning in the text holds for a linear profit-productivity curve. More competition appears from a steeper slope of that relation. In contrast, the profit-productivity curve in figure 2.1 is S-shaped. The tails have economic significance. Boone (2000) argues that more competition for firms in the high-efficient tail is an incentive for them to develop and launch new products and not to improve their production processes. In contrast, firms in the low-efficient tail abstain from innovation at all if competition intensifies. The type of innovation is not the topic of this paper, and therefore, the form of profit-productivity curve is not essential unless it is not positively related to competition.

variable costs as an approximation. Using regression techniques, the slope β in the basic relationship estimates the relative profits measure:

$$\log \pi_{it} = \alpha - \beta \log c_{it} + \varepsilon_{it}$$

with π_i the gross profit of firm i and c_i its marginal costs. A high relative profits measure ($=\beta$) corresponds with a high level of competition. In fact, β is estimated as an elasticity i.e. percentage increase in profits due to a 1 percent decrease in marginal costs.

In order to estimate the relative profits measure accurately, we adjusted the basic equation for firm-specific effects.⁵

2.2.2 Price-cost margin

The price-cost margin – also known as ‘Lerner index’ – refers to the firm’s ability to set its prices above its marginal costs. The idea is that fiercer competition is reflected by lower price-cost margins due to lower prices. If there are many competitors on a market with a low level of demand, then competition forces the firms to reduce prices until marginal costs. In case of perfect competition, prices are equal to marginal costs. Each individual firm cannot affect the prices on the product market. At the other extreme, a monopolist experiences no competition at all and thus can set the highest price to maximise profits.⁶ In the range from no competition to perfect competition, the price-cost margin falls.

Price-cost margins based on structural approach

The price-cost margin can also be derived from identifying parameters of a demand and cost function. Another similar way to measure the price-cost margin is an approach initially put forward by Hall (1996) to measure the Solow residual and the mark-up (price over marginal costs). Hall pointed out that the mark-up can be estimated by using Solow’s equation, differentiating between inputs and exogenous technological progress (see Ahn, 2002). Several studies have elaborated on this alternative as to overcome econometric issues (see Oliveira Martins et al. 1996).

Measurement of price-cost margin

The price-cost margin of industry j is defined as the (weighted) sum of the price-cost margin of individual firms, each weighted by the firms’ market share in output. The price-cost margin of firm i is denoted as $(p_i - c_i)/p_i$, where c_i represents the marginal costs and p_i the price of firm i . This memorandum measures the (weighted) industry price-cost margin as (see box for alternative approach):

⁵ It turned out that if we do not control for firm fixed effects the relative profits measure will not always attain the appropriate sign.

⁶ In case of high economies of scale, a monopoly with a high price-cost margin is sustainable. High investment costs and substantial economies of scale by incumbents entail that entry of new firms is not profitable. Also from a social point of view entry is less desirable, because total demand and firms’ individual output will be too small in relation to the high investments. In case of entry, firms cannot sufficiently benefit from the economies of scale.

$$PCM_t = \sum_i \left(m_{ti} * \frac{P_{ti} - c_{ti}}{P_{ti}} \right) \approx \sum_i \left(m_{ti} * \frac{s_{ti} - v_{ti}}{s_{ti}} \right) \text{ with } m_{ti} = \frac{s_{ti}}{\sum_i s_{ti}}$$

where p_{ti} denotes the price of firm i in year t , c_{ti} its average variable costs, v_{ti} total variable costs, s_{ti} value of total output, and m_{ti} denotes the market share. So, the average variable costs approximate the marginal costs.⁷

2.2.3 Labour-income ratio

The labour-income ratio is the share of labour costs in net value added. The idea is that a high labour-income ratio points to fierce competition, because then profits are low and value added consists largely of labour costs. The labour-income ratio is conceptually closely related to the price-cost margin, because the latter is approximately equal to 1 minus the labour-income ratio.⁸ This measure is chosen as an alternative for the price-cost margin because CPB frequently publishes the labour-income-ratio in its forecasts (see section 3).

Measurement labour-income ratio

The labour-income ratio for an industry is defined as:

$$LIQ_t = \frac{\sum_i l_{ti}}{\sum_i (s_{ti} - ic_{ti} - d_{ti})}$$

with l_{ti} labour costs of employees and self-employed persons, ic_{ti} intermediate costs and d_{ti} depreciation cost of firm i in period t .

2.2.4 Concentration ratio: Herfindahl index

A concentration ratio measures the concentration of firms' market shares in some delineated market. The idea behind concentration ratios is that fiercer competition is reflected by less concentration, so a fall in the ratio. A number of concentration ratios are available. This memorandum investigates the so-called Herfindahl index. This index is high if a few firms have large market shares and dominate the market. Concentration in market shares may point to market power to set prices above marginal costs,⁹ or to potential collusion and abuse of dominant positions.¹⁰ The extreme case is a monopolist. In that case, the Herfindahl index is equal to 1 as one firm holds 100% of the market. If many firms prevail on the market and each

⁷ In practice, variable costs consist of labour costs and the cost of intermediate products.

⁸ To be precise: $(PCM - D/P)P/NVA$, where D is depreciation costs and NVA denotes net value added.

⁹ See Cabral (2000). In fact, the industry price-cost margin is equal to the Herfindahl index multiplied by the consumer price elasticity.

¹⁰ See Tirole (1988), with references to Bain (1951) and (1956).

one possesses a small market share, no domination in the market exists and the Herfindahl index approaches zero.

Measurement of Herfindahl index ¹¹

The Herfindahl index is computed as:¹²

$$HHI_t = \sum_i \left(\frac{s_{ti}}{\sum_i s_{ti}} \right)^2$$

Due to the squaring procedure, greater emphasis is placed on the large firms in the market.

2.3 Data sources

2.3.1 Firm-level data

The relative profits measure, the price-cost margin and the Herfindahl index are based on firm-level data. These data are derived from the yearly survey among enterprises carried out for the 'Productiestatistieken' (PS) by Statistics Netherlands. The survey gives complete coverage of firms with at least 20 employees, while firms with fewer than 20 employees are sampled.¹³

This memorandum focuses on the period 1993-2001 since for this period the largest consistent firm-level dataset is available. This dataset has been constructed after linking the detailed accounting data over time. Table 2.1 presents an overview of the main sectors where data are available. The dataset covers a large part of the Dutch market sector.¹⁴ This study cannot observe the agriculture and fishing industry, banking and insurance, public utilities and health care industries, because of data availability. Eventually, the database contains information of 87 000 firms in the Netherlands across 119 industries at the 3-digit SIC-level.¹⁵

¹¹ Another indicator of concentration is the market share of the largest x firms, the so-called Cx-ratio. This indicator has the advantage to the Herfindahl-index that it does not require the information of all firms. The disadvantage is that the Cx-ratio does not consider the skew of the distribution in market shares. For example, a market of 20 symmetric firms has the same C10-ratio (0.5) as a market consisting of a dominant firm with 45.5% market share, nine smaller firms with 0.5% market share each and a large fringe of 1000 firms with each 0.05% market share.

¹² Likewise the price-cost margin, the Herfindahl index is adjusted to generate population results using the raising factor of the sample.

¹³ The raising factor is used to generate population results.

¹⁴ Note, that not every industry within manufacturing or services is included in the PS as well. For instance, for the transport sector no information is available for industries like railways. In addition, firms belonging to the financial and insurance industries are lacking

¹⁵ SIC stands for the "Standaard Bedrijfsindeling", the 1993 version of Statistics Netherlands.

Table 2.1 Overview of available data for selected industries

Sector	SIC-code	Period
Manufacturing	151-366	1978-2001
Construction	45	1982-2001
Retail	52	1988, 1990, 1992-2001
Wholesale	50-51	1988, 1990-2001
Transport	6	1993-2001
Other services	55, 7	1989-2001

The accounting data in the PS include – amongst others – the following key variables needed to measure the competition indicators based on firm-level data: gross output, intermediate inputs and wages (including social security charges).

2.3.2 National Accounts

The input-output tables of the National Accounts by Statistics Netherlands provide data from which the labour-income ratio can be computed at the industry level. This data source also allows calculating the price-cost margin. Hence, for the latter we have computed two observations, one based on firm-level data and one based on National Accounts data.

In principal, competition changes over time at aggregated levels are the aggregated results of lower levels of aggregation. However, the results for the development of competition need not necessary to be identical between the both sources employed in this memorandum, because the National Accounts data mirrors procedures used to integrate different data sources. Although firm-level data is a main source for the National Accounts data, other (micro level) sources are used as well. To provide a consistent review of the national economy at aggregated levels, an integrating framework is used in line with international concepts and classifications of the National Accounts.

2.3.3 Matching and cleaning both sources

As the firm-level data are the benchmark in this memorandum, we merged the National Account industries to the industries from the firm-level data. At the 3-digit SIC-level, we were able to link 72 National Account industries. Therefore, at the outset, we have at our disposal 120 industries derived from firm-level data and 72 comparable National Account industries. Hence, some National Account industries consist of more 3-digit industries based on firm-level data.

Original (unprocessed) firm-level data can be erratic due to wrong or suspicious answers of firms. In order to obtain reliable firm-level data, several cleaning activities were necessary at

the outset.¹⁶ Measurement issues related to implausible results of one or more competition indicators reduced the dataset to 100 industries based on firm-level data (see appendix A).

2.4 Conclusions

This chapter describes the four indicators for measuring competition and the two data sources. The indicators are the relative profits measure, the Herfindahl index, the price-cost margin and the labour-income ratio. The relative profits measure is a new competition measure. This new measure, the Herfindahl index and the price-cost margin are derived from a database of 87 000 firms. The labour-income ratio comes from the input-output tables of the National Accounts. This data source also allows calculating the price-cost margin. Hence, for the latter we have two observations, and in totality, we analyse five indicators.

As the firm-level data are the benchmark in this memorandum, we merged the two sources and were able to link 72 National Accounts industries to 100 industries derived from firm-level data. Data availability limits the analysis to the period 1993-2001.

¹⁶ We employed five basic cleaning activities on the dataset: 1) firms with no turnover and employment were neglected; 2) firms with negative value added were also deleted; 3) firms with turnover less than labour costs were removed; 4) firms with identical output and employment data in two consecutive years were ignored; 5) firms with huge changes in key variables as output and employment were also removed from the dataset.

3 Theoretical and empirical assessment of indicators

All competition indicators have theoretical and statistical shortcomings in measuring competition. In theory, compared to the relative profits measure, the price-cost margin and the Herfindahl index may point in the opposite direction for the development of competition, because they respond differently to a reallocation of output from inefficient to efficient firm. All indicators are to some extent biased because the available data do not fully fit the needs for good measurement. Particularly, defining the relevant market is a notorious problem, mostly for the Herfindahl index.

3.1 Introduction

This chapter assesses the indicators in terms of theoretical requirements and measurement requirements in practice. From a theoretical perspective, it looks at how the indicators evolve when important parameters of competition change, for instance, when entry barriers are reduced (see section 3.2). This chapter also elaborates on empirical issues that might affect each indicator (see section 3.3). Amongst others, we discuss the consequences for defining the relevant market for each indicator.

3.2 Theoretical assessment of indicators

3.2.1 The profit margin effect and reallocation effect of competition

In order to assess the indicators, it is useful to distinguish two related effects of more competition if firms differ in their efficiency level.¹⁷

- *Profit margin effect:* In general, prices will be lower, reducing the profit margin of each firm. The price-cost margins of efficient firms, however, will fall less than those of inefficient firms.
- *Reallocation effect:* Efficient firms increase their output compared to inefficient firms, because efficient firms can reduce their prices relatively more than inefficient competitors can as their profit margins were originally higher.

It will be argued that the relative profits measure, the price-cost margin and the Herfindahl index may point in the opposite direction for the development of competition if the reallocation effect is considerable. Generally, reallocation effects only emerge if firms compete with different starting points (e.g., efficiency levels) and have different market shares. Only if firms have the same efficiency levels and changes in competition do not affect this equality, then

¹⁷ This approach is realistic. Looking at firm-level studies, firms turn out to be very heterogeneous in many aspects. Note that if all firms are equally efficient, the relative profits measure cannot be measured.

shifts in market shares or reallocation effects do not occur unless there is entry of new firms. The box illustrates how shifts in market shares can occur.

Causes of shifts in market share

Hay and Liu (1997) state that shifts in market shares are related to efficiency levels, price elasticity of demand, conduct of firms and number of firms on the market. They derive a mathematical relation between a firm's market share m_i and its relative marginal costs (c_i/\bar{c}), the price elasticity of demand (ε) and the conjectural variation (λ), i.e. the competitors' response to price or output changes of an initiating firm. If competitors charge similar prices then:

$$m_i = \frac{s_i}{\sum_j s_j} = \frac{\varepsilon}{1+\lambda} - \left(\frac{\varepsilon}{1+\lambda} - \frac{1}{n} \right) \frac{c_i}{\bar{c}}$$

This equation suggests that a firm's market share is linear related to its relative costs.^a It also shows that the market share of any incumbent declines if the number of firms (n) increases. Shifts in market shares or, stated otherwise, reallocation effects are less pronounced if the number of firms (n) is already high. Further, if the price elasticity (ε) increases or competitors' response (λ) declines, then efficient firms (with $c_i \leq \bar{c}$) gain market share at the expense of inefficient firms (with $c_i \geq \bar{c}$). So in these two latter cases the market becomes more concentrated.

^a Likewise the relative profits measure, the Herfindahl index can be linked to the dispersion in efficiency levels as well.

Both Boone (2000) and Boone et al. (2005) investigate the conceptual differences between competition measures from a theoretical point of view. According to these studies, the relative profits measure should be unambiguously related to changes in competition, in contrast to the (industry) price-cost margin and the Herfindahl index. In fact, the reallocation effect may bias the price-cost margin and the Herfindahl index.

Boone (2000) theoretically proves that intensifying competition entails more emphasis on rewarding efficiency advantages. Put differently, more competition results in a shift in relative profits from inefficient firms to efficient firms. The relative profits measure will increase, whereas the Herfindahl index and the price-cost margin may provide ambiguous information in case of aggressive conduct of efficient firms. If fiercer competition results in a reallocation of output from inefficient firms to efficient firms, this could either lead to a fall or rise in the Herfindahl index and the price-cost margin as discussed below.

The Herfindahl index focuses on the reallocation of market shares. If aggressive conduct affects either the market shares of inefficient firms (reallocation effect) or forces them out of the market (selection effect), it increases the concentration rate, which then suggests that competition became less fierce.

The price-cost margin combines reallocations of output with the shifts in firms' profitability. In fact, the (industry) price-cost margin is related to firms' market shares and their individual price-cost margin. In general, more competition will reduce the price-cost margin of each

firm.¹⁸ However, if conduct becomes more aggressive, market shares are reallocated from inefficient firms (with low price-cost margins) to efficient firms (with high price-cost margins). If the latter (reallocation) effect on industry wide price-cost margin is positive and larger than the negative individual price-costs effects, the price-cost margin at the industry level may rise, suggesting less competition.

Table 3.1 Impact determinants on market shares, firms' price-cost margin and competition indicators

Determinant	Reallocation of		Impact on		
	Output (market shares) ^a	Profits (firms' price-cost margin) ^b	Relative profits measure	Industry price-cost margin	Herfindahl index
More dispersion efficiency levels among firms	ms_i rises ms_{ni} drops	pcm_i rises pcm_{ni} drops	Rises	ambiguous	ambiguous
More product substitutability	ms_f rises ms_{nf} drops	pcm_f ambiguous pcm_{nf} drops	Rises	ambiguous	rises
Lower entry barriers	ms_e rises ms_f drops ms_{nf} drops	pcm_e rises pcm_f drops pcm_{nf} drops	Rises	drops	drops
Wage moderation	ms_f drops ms_{nf} rises	pcm_f rises pcm_{nf} rises	Drops	ambiguous	drops
Market size increases	ms_f drops ms_{nf} rises	pcm_f rises pcm_{nf} rises	Drops	ambiguous	drops

^a ms_f and ms_{nf} denote the market share of the efficient incumbent and respectively the inefficient incumbent, ms_i and ms_{ni} denote the market share of any innovating incumbent and respectively any non-innovating incumbent. ms_e denotes the market share of the entrant.

^b pcm_f and pcm_{nf} denote the price-cost margin of the efficient incumbent and respectively the inefficient incumbent, pcm_i and pcm_{ni} denote the price-cost margin of any innovating incumbent and respectively any non-innovating incumbent. pcm_e denotes the price-cost margin of the entrant.

3.2.2 How do indicators react?

This section illustrates with some examples how the indicators theoretically react on changes in the following parameters related to competition:¹⁹

- More dispersion in efficiency among firms
- More product substitutability
- Increase in number of firms
- Wage moderation
- Increase in market size

¹⁸ In case of more product substitutability, efficient firms could even increase their price-cost margin.

¹⁹ The results are based on simulations with a linear demand model, where firms differ in their efficiency level and entry occurs if a firm can make profits. Entrants have the lowest efficiency level.

Table 3.1 summarizes their impact on output (reallocation effect) and on individual price-cost margins (profit margin effect), and eventually on the three competition indicators.²⁰ The table shows that the indicators do not always agree on the direction of change in competition. Below, we explain the impact of each determinant separately.

More dispersion in efficiency among firms

Assume firms innovate their production processes. This may have an impact on the variety of the efficiency levels among the firms within a market. The consequences for the indicators are as follows. Cost reducing innovations by individual firms have an ambiguous impact on the Herfindahl index and the price-cost margin, but raise the relative profits measure.

Innovation entails a reallocation of output towards the innovating firm, and an increase in its individual price-cost margin at the expense of the non-innovating firms. The eventual impact on the Herfindahl index and the price-cost margin also depends on the consequences for the reallocation effect. The latter depends on the innovator's initial efficiency level and the gain from innovation and successive reallocation effects. Lack of such information makes a general statement on these two indicators cumbersome. In contrast, the relative profits measure increases if any firm reduces its marginal costs due to innovation (see Boone, 2000). The underlying idea is that the non-innovating firms (read inefficient firms) will be confronted with more efficient firms, which induces more competition.

More product substitutability

If product substitutability increases, non-price characteristics of products become less important. Then firms compete more on prices and efficiency levels. Consequently more product substitutability induces aggressive behaviour among firms as efficient firms can better exploit their competitive advantage compared to inefficient firms. Therefore, higher product substitutability will affect inefficient firms more and they have to incur more losses than efficient firms will.

In that case, the relative profits measure will increase suggesting more competition because the relative profits of inefficient firms will decline at the benefit of efficient firms. In contrast, the Herfindahl index will rise and will point to less intense competition. This opposite outcome is the result of the fact that more product substitutability may also reallocate output towards efficient firms, or even force inefficient firms to exit (selection effect). As a result, the market shares become more skewed or the number of firms decline. Both effects raise the concentration rate.

²⁰ We focus on the indicators derived from firm-level data to keep the table handy. The two indicators derived from the National account respond in the same way as the price-cost margin based on firm-level data.

The impact of increased product substitutability on the industry price-cost margin is ambiguous for two reasons. First, in most cases the individual price-cost margin of each firm declines, as prices will go down due to more competition. However, in some particular cases (highly) efficient firms could even raise their prices to just below the prices of the (inefficient) competitors.²¹ Then, more product substitutability could lead to an increase in individual price-cost margin instead of a decrease. This thwarts an unambiguous statement on firms' individual price-cost margin. Second, if efficient firms gain market share²² and/or if inefficient firms are forced to exit (selection effect), then the distribution of individual price-cost margins becomes more skewed towards the efficient firms. Since the efficient firms always have a relatively higher individual price-cost margin, the weighted industry price-cost margin will rise, pointing to less competition.

Increase in number of firms

If the number of firms in a market increases due to lower entry barriers, this will induce reallocation effects changing the market shares. As a result, the Herfindahl index will decline because the market shares of each incumbent will shrink. More entry also reduces the industry price-cost margin. In fact, all incumbent firms are equally forced to cut prices because they have to recoup sufficient output in order to cover fixed costs. The relative profits measure will rise. More competitors and lower individual price-cost margins will harm inefficient firms more than efficient firms. Therefore, the profits of inefficient firms will relatively decline compared with efficient firms. Hence, all indicators will point to more competition due to lower entry barriers.

Wage moderation and increase in market size

Macro-economic developments entailed an economy-wide wage moderation in the mid 1990s and an increase in market sizes in the second half of the 1990s (see CPB, 2005). Both developments may result in a decline of the relative profits measure, which suggests a decline in competition. In fact, both determinants provide inefficient firms the opportunity to increase their output and recoup some market share at the expense of the efficient firms.²³ Consequently, the reallocation of output entails a decrease in the Herfindahl index. This reallocation also clouds the impact of both determinants on the price-cost margin. Wage moderation and growth

²¹ In fact, they do not have to overrule the competitors' non-price attributes by reduced prices as to satisfy quality-demanding customers.

²² Irrespective of the fact that profits of the efficient firms will increase or decrease.

²³ Assume that firms have equal price elasticities on own and competing products. Then simulations reveal that if the market size increases, the absolute volume growth in total demand is equally divided across the incumbent firms. At the same time, the prices of all firms are raised by the same amount. The absolute change in total sales of the efficient firms is slightly higher than the absolute change of the inefficient firms. However, the *percentage* change in total sales of the inefficient firms is much higher than the percentage change of the efficient firms. The latter result entails that efficient firms lose some market share to the inefficient firms. It is unclear whether these results hold if the price elasticity varies across firms.

in market size have a positive impact on the individual price-cost margins of every incumbent, and thus on the industry average of price-cost margins. However, the denoted reallocation may affect the initial rise of the industry price-cost margin. Speaking technically, the reallocation shifts the gravity of the industry average in price-cost margins towards the lower individual price-cost margins of the inefficient firms.

Special cases: competition for the market and collusion

Competition authorities are particularly interested in cases where firms compete for the market, i.e. when firms compete for the exclusive right to penetrate a market for a predetermined period.²⁴ Then, the relative profits measure as well as the other indicators cannot detect changes in competition. The Herfindahl index is not relevant because the firm has a 100% market share. The relative profits measure cannot be computed because there is only one firm (unless we incorporate the potential entrants in computing the measure). Finally, the price-cost margin may increase if the efficient entrant gets the new contract and actually replaces the inefficient firm. The price-cost margin would then point to a decline in competition.²⁵

Competition authorities are also interested in markets where firms collude or abuse their market power. Both the Herfindahl index and the price-cost margin cannot detect collusion or abuse of dominant positions. It is questionable whether the relative profits measure can do this. First, the measure assumes that firms choose their strategic variable simultaneously and independently (see Boone, 2000). However, in case of collusion or predation of potential entrants, for instance, incumbents monitor their (potential) competitors behaviour and will change their strategy if any competitor deviates from the status quo.²⁶ Second, as discussed, the relative profits measure takes into account reallocation effects in its judgment on the change in competition. However, the question can be posed whether the relative profits measures always treat (large) reallocation effects correctly. The latter can have a negative effect on the extent of competition if efficient firms become more unlevelled and abuse their dominant (monopolistic) positions. Consequently, the market could become more concentrated, particularly if the inefficient firms are forced to leave the market.

²⁴ During a granting procedure firms may subscribe a tender for supplying network services during some period, say 5 or 10 years. Then the government or supervisor may award the exclusive supply contract to one of the subscribers. At the end of the period, a granting procedure will be organized for the next period of 5 or 10 years. For example, as an experiment exclusive railway contracts for smaller regions in east and northeast Netherlands have been granted to regional operating railway companies (Syntus and NoordNed).

²⁵ Competition for the market may be enhanced if efficient entrants threaten to replace the inefficient incumbent (see Aghion and Howitt (1996)). In fact, entrants may find it more profitable to innovate than an incumbent. Innovation makes the old technology of the incumbent obsolete and generates capital destruction. Entrants do not incorporate the capital destruction in their decision to innovate, but incumbents do.

²⁶ In case of collusion, the colluding incumbents will punish the firm that deviates from the collusive agreement (i.e. if deviating is detected). In case of predation, the incumbent will temporarily undercut prices as potential entrants consider entering the market (see e.g. Cabral (2000) and Tirole (1988), for further references).

Wrap up

To conclude this section, the indicators do not always agree on the direction of changes in competition. In theory, the price-cost margin and the Herfindahl index may point in the opposite direction for the development of competition than the relative profits measure. The latter responds differently to a reallocation of output from inefficient to efficient firms.

3.3 Empirical assessment of indicators

Before starting, it should be stressed that the empirical analysis in this memorandum mainly considers the *change* in competition and not the *level* of competition. Therefore, measurement issues that cloud the competition results are more relevant if they are primarily related to changes over time.

Assessment criteria

To assess the indicators from an empirical perspective, we focus on the following criteria:

- Relevant market;
- Data requirements;
- Availability of data.

3.3.1 Data weakly fit the relevant market

Measuring relevant markets difficult

In practice, it is a notorious problem to delineate the relevant market for competition issues. This requires information on the substitutability of the products and product attributes, and on the region in which the suppliers operate. These characteristics of the markets may be quite manageable in theory, but provoke many questions in practice for researchers. For example, cases investigated by competition authorities are often liable to assessing the relevant market. Further, determining whether markets entail a level playing field is rather cumbersome. Questions that must be addressed are, for instance: What is the extent of product substitutability? Do firms compete on local, national or international markets? Due to a lack of detailed information, researchers are mostly forced to simplify their empirical analysis.

Bias relevant market affects all indicators

This memorandum defines the relevant market to be the 3-digit SIC-level at the national level. The latter implies that we do not look at local, regional or international markets, but that we

assume that firms compete within these industries at the national level. Moreover, we suppose that competition takes place between firms instead of products.²⁷

In this respect, the dataset is very heterogeneous. Industries within the manufacturing industry are more likely exposed to foreign competitors, whereas parts of the services sectors are oriented to regional or even local markets. Hence, measuring competition indicators at the 3-digit level instead of the relevant market (if possible at all) may distort the conclusions on the course of competition.

Although this aggregation level could be far-fetched in terms of the relevant market, even then the available firm-level data of the Dutch economy offers the opportunity to distinguish almost 120 industries over the period 1993-2001. The competition indicators derived from the National Accounts are based on more aggregated data of 3-digit level markets than the firm-level data.

Compared to the other indicators, the Herfindahl index is most sensitive to the issue of defining the relevant (geographical) market, as computing the market shares requires information of the total sales of all domestic and foreign competitors. The other indicators are more or less based on averages and ratios and therefore generally less sensitive.

3.3.2 Data requirements

Some indicators biased due to mis-measurement marginal costs

Both the relative profits measure and the price-cost margin depend on the concept of marginal costs. However, these costs are neither observed at the industry level nor at the firm level. As is standard in the empirical literature, we approximate the firms' marginal costs by the average variable costs.²⁸ This may bias the results for both indicators.

Another bias is that R&D-expenditures belong to the variable costs, while they economically are regarded as investment costs. This bias influences the levels of the relative profits measure and the price-cost margin. However, it is less likely that this bias has a considerable impact on the change of both indicators, which is the relevant issue of this memorandum.

Bias due to sample problems

The firm-level dataset is based on a yearly sample and changes over time regarding the number of firms. Both factors may bias the results for the indicators derived from these datasets.

The sample characteristic is most apparent for the average size of the firm. The average size of firms in our dataset is considerably higher than actually measured for the total population of

²⁷ Implicitly, we assume that if we refer to an efficient firm, this firm produces all its products most efficiently.

²⁸ I.e. the sum of the purchasing costs of intermediate products and labour costs, divided by the total sales.

firms. For instance, the Dutch services sector consists of many small firms and – due to the sampling design – many of them are only occasionally covered in the PS.

Table 3.2 Representativeness of firm-level data,1996

	Population	Survey	Coverage
	Number of firms		In %
Manufacturing	50445	3721	7,4
Services sector	444659	20614	4,6

In order to cope with sample problems (including cutback of the sample), Statistics Netherlands assumes that the surveyed small- and medium-sized firms are representative for the entire group of small and medium-sized firms. Aggregating to the industry level population, the bureau multiplies the results of each small firm in the survey with a raising factor, and adds them to the results of larger firms.²⁹

This memorandum also employs these raising factors to compute the Herfindahl index and the price-cost margin to circumvent the problem of not observing the total output of a market.

Confidentiality or lack of competition: a potential trade-off?

Due to confidentiality rules of Statistics Netherlands, we had to delete some 3 digit-industry observations. Such censorship may have essential and intrinsic reasons. Is the lack of observations for a particular industry due to small sample or due to concentrated market with lack of competition? A potential trade-off?

Researchers using micro-data of Statistics Netherlands are not allowed to publish results for industries that are (potentially) traceable to figures of individual firms. Therefore, results cannot be published if they are largely based on figures of only a few firms (being sampled). However, results may neither be published if they are largely determined by figures of dominant firms with large market shares.^a The latter case, however, points to limited competition and does refer to intrinsic censorship. If anything, industries that refer to the latter case are interesting to investigate.

^a Note that if in reality there are only a few firms in the market, then all or at least some firms have a large market share and a dominant position by definition.

Bias due to missing data

Measuring the indicators from firm-level data encounters another problem. For several industries, observations of small firms are missing. In fact, data of firms with 20 employees or less in manufacturing sectors are missing for 1993-1995, and data of firms with 20 employees or less in the wholesale sectors are missing for 1996 and 1998-1999. To prevent substantial jumps in competition indicators due to temporarily missing observations, we only used

²⁹ The raising factor is defined as the total number of small firms, observed in the ABR-statistics, divided by the number of small firms that are surveyed. Within the group of smaller firms, different stratum are distinguished each with an own raising factor.

observations of firms with more than 20 employees for the whole period for manufacturing and wholesale. This may again bias the results of the indicators derived from firm-level data, particularly the Herfindahl-index and the price-cost margin.

In principal, both the sample problem and missing data of small firms also hold for the indicators derived from the National Accounts.³⁰ However, both problems are probably less severe, because the National Accounts uses additional data sources, such as the labour-accounts, to provide a consistent view of the national economy at aggregated levels.

Finally, the relative profits measure neglects firms with losses due to its log specification of the equation. Hence, the dataset to compute this competition indicator differs from the other indicators and can affect the coherence with other indicators.

3.3.3 Availability of data

In general, policy makers and competition authorities want to have adequate information on competition development as soon as possible in order to respond rapidly if necessary. In fact, they face a trade-off between speed and quality of information, as the earlier the information is available, the lower its quality. It is seemingly that the data quality improves if the delay becomes longer, because more information becomes available in the course of time. This information can be processed to consistent and more detailed figures.

When we look at the selected indicators, we conclude the following. The labour-income ratio can be observed at first, since CPB frequently provides forecasts of it. Annual figures for the previous year are published in the National Accounts each summer. Consequently, preliminary estimates of the price-cost margin based on the National Accounts become available after half a year.³¹ Both indicators derived from the National Accounts data turn into final estimates after two years. This memorandum explores the final data of the National Accounts. The competition measures derived from firm-level data are only available after a delay of two years, when the firm-level data becomes public assessable for researchers.

3.4 Conclusions

This chapter assesses the competition indicators from a theoretical and empirical perspective. It illustrates how indicators theoretically react on changes in a number of parameters related to competition such as more dispersion in efficiency levels among firms, more product

³⁰ We assume that Statistics Netherlands employs a similar cleaning process of the firm-level data as we have done.

³¹ I.e. apart from the revisions, for example due to changes in the standard industry classification (SIC) or changes in the definition of variables.

substitutability and increase in number of firms. The indicators do not always agree on the change in competition if reallocation of market shares from inefficient to efficient firms occurs. Compared to the relative profits measure, the price-cost margin and the Herfindahl index may point in the opposite direction for the development of competition, because they respond differently to a reallocation of output from inefficient to efficient firms.

To assess the indicators from an empirical perspective, we focused on the following criteria: relevant market, data requirements and availability of data. All indicators are to some extent biased because the available data do not fully fit the needs for good measurement. The relative profits measure and the price cost-margin mis-measure competition because they use the average variable costs instead of marginal costs. Moreover, all indicators are biased due to problems of defining the relevant market, particularly the Herfindahl index.

4 Competition Dutch market sector

We do not find evidence that competition increased economy-wide from 1993 to 2001. Instead, most indicators point to a decline at the aggregated level. This is partly due to a shift in the industrial structure to services industries with on average less intense competition. Most competition measures indicate that the extent of competition in manufacturing became less fierce over time. The story for the services sector is inconclusive. Neglecting changes in the structure, the course of competition is less clear-cut at the industry level. Although competition changes have been rather small in many of them, a considerable number of industries experience a sharp rise or strong fall in competition.

4.1 Introduction

This chapter discusses the main question of this memorandum how the intensity of competition in the Netherlands evolved over the period 1993-2001. It presents the results of competition at three different levels of aggregation: macro level, sector level and industry level. Section 4.3 focuses on the market sector. Next, section 4.4 discusses the corresponding results for manufacturing and the services sector. Section 4.5 describes the course of the competition at the industry level. Before doing so, section 4.2 discusses two approaches how to aggregate changes in competition in individual industries to provide an overall impression on how competition developed at higher levels of aggregation over time. Section 4.6 concludes.

4.2 Two methods of aggregation

The problem

For each indicator, we compute the level and the annual growth rate of competition for each industry. To get an overall view for the market sector at large, it is clear that those results must be aggregated. Obviously, competition changes of large industries should have more weight than competition changes of small industries. However, the precise definitions of the weights depend on how one interprets competition between industries within the market sector.

Two extreme approaches

We employ two approaches to aggregate competition over industries. First, we assume that changes in competition within industries do not affect the industrial structure, and use fixed weights to aggregate. The second approach assumes that changes in competition at the industry level also affect the industrial structure. Both approaches differ if changes in the industrial structure occur, but they increasingly correspond if changes in the structure are smaller (see box for the formulas).

Approach 1: No competition between industries

The first approach assumes that changes in the level of competition in the market sector entirely depend on competition changes of each industry separately. We assume no substitutability of products between industries despite changes in the relative prices due to competition. Hence, we argue that changes in competition within industries do not affect the industrial structure.

Defining competition growth on the market sector: the formulas

Given the two approaches, the formulas of the competition growth rates for the market sector are denoted as follows.

Approach 1: No competition between industries

Competition growth of the market sector in year t is defined as $\overset{\circ}{c}_t = (\Delta c_t)/c_{t-1}$ with

$$c_t = \sum_i (c_{i,t} * s_{i,1993})$$

where c_{it} denotes the competition intensity of industry i , $s_{i,1993}$ denotes the share of industry i in the turnover of the market sector in 1993.

Approach 2: Competition between industries

Competition growth of the market sector in year t is defined as $\overset{\circ}{c}_t = (\Delta c_t)/c_{t-1}$ where $c_t = \sum_i s_{it} c_{it}$; s_{it} denotes the share of industry i in the turnover of the market sector and c_{it} denotes the competition intensity in industry i (levels instead of indices 1993=100). This expression is the sum of three components, viz. competition growth due to competition changes within industries, to changes due to shifts in the industrial structure and to the interdependency between changes in competition of industries and changes of the industrial structure. The decomposition can be expressed as follow:

$$\overset{\circ}{c}_t = \left(\begin{array}{l} \sum_i \left(\frac{c_{i,t-1}}{c_{t-1}} s_{i,t-1} \right) \overset{\circ}{c}_{it} \quad \text{within - industry component} \\ + \sum_i \left(\frac{c_{i,t-1}}{c_{t-1}} \right) \Delta s_{it} \quad \text{between - industry component} \\ + \sum_i \left(\frac{c_{i,t-1}}{c_{t-1}} \right) \overset{\circ}{c}_{it} \Delta s_{it} \quad \text{cross component} \end{array} \right)$$

The term $c_{i,t-1}/c_{t-1}$ measures the deviation of competition intensity of industry i from competition intensity in the market sector in the previous year.

This approach requires that the industrial structure is fixed to the situation in 1993. Therefore, competition growth of the market sector equals the fixed weighted sum of the competition level

of the industries over time. The 1993 market shares (in terms of turnover) of each industry in the market sector are used as fixed weights.³²

Approach 2: Competition between industries

A second way to aggregate competition across industries is to assume that differences in competition intensities across industries do have real economic consequences. Products of industries are to some extent substitutes. Hence, if changes in competition at the industry level alter the relative prices between the industries, it also affects the industrial structure. This approach can be implemented by using a shift-share analysis. Such analysis allows us to decompose competition growth at the aggregated level as follows:

- The ‘within-industry component’ includes the competition growth due to changes in competition of the industries with weights of the previous year. The economic interpretation comes close to the interpretation of competition growth according to approach 1 except that the weights are not fixed but flexible.
- The ‘between-industry component’ reflects competition changes at the aggregated level due to shifts in the industrial structure. If the structure shifts to industries with higher levels of competition, then competition in the market sector rises, even if competition within industries remains unchanged.
- The ‘cross component’ presents the competition development as the product of changes in competition across industries and changes in the industrial structure. If both elements are positive or negative, they contribute to more competition in the market sector.

The ‘between-industry component’ primarily depends on differences in structural economic growth between industries. In general, shifts in the economic structure arise from differences in income elasticities across the industries as well as differences in price elasticities of demand. The industrial structure also depends on the development of (labour) costs in the Netherlands compared with foreign countries. Shifts in competition affect relative prices and therefore may alter the industrial structure but presumably, this effect is small.

³² Note that this method does not control for measurement problems regarding comparing levels of competition across industries. Indexing the levels of competition of each industry to 1993 is not an adequate solution because the aggregated result will then be biased towards an index larger than 1993.

4.3 Market sector

4.3.1 Results approach 1

Table 4.1 presents the average annual growth rates of the Dutch market sector between 1993 and 2001 according to both approaches.³³

Table 4.1 Trends competition growth market sector between 1993 and 2001						
Conditions	Approach 1	Approach 2				
Industrial structure	Fixed to 1993	Flexible	Components			
		Total	Within-industry	Between-industry	Cross	
Average percentage annual competition growth						
Firm-level data						
Relative profits measure	- 0.49	- 1.59	0.28	- 1.76	- 0.09	
Price-cost margin	- 1.00	- 1.26	- 0.58	- 0.20	- 0.53	
Herfindahl index	- 1.20	- 1.40	- 1.45	- 0.01	0.08	
National Accounts						
Price-cost margin	0.62	0.33	0.58	- 0.22	- 0.01	
Labour-income ratio	- 0.63	- 0.67	- 0.62	0.13	- 0.17	

We start with the results for approach 1 (see table 4.1, second column). It turns out that most indicators point to less intensified competition in the Dutch market sector over time. However, this conclusion partly depends on the data source. All indicators derived from firm-level data indicate a decline in competition. The labour-income ratio based on the National Accounts signals a decrease in competition at the aggregated level as well. In contrast, the National Account price-cost margin points to a rise in competition. Remarkably, the price-cost margin based on firm level data and the price-cost margin based on National Account data disagree on the direction of change in competition.

³³ To improve the comparability between the indicators, we have harmonized the developments of the indicators in the following way. For each indicator we assume that the index starts at 100 in 1993, so the level of competition in 1993 is the starting point. Then the value of the index of the relative profits measure equals its value of the previous year plus the annual percentage change of the relative profits measure, because an increase in the relative profits measure entails more competition. The value of the index of the price-cost margin equals its value of the previous year *divided* by the annual percentage change of the price-cost margin, because increases in the price-cost margin would point to decreases in competition. The index of the Herfindahl index is similarly calculated as the index of the price-cost margin.

Figure 4.1 Competition Dutch market sector (1993=100): approach 1, 1993-2001

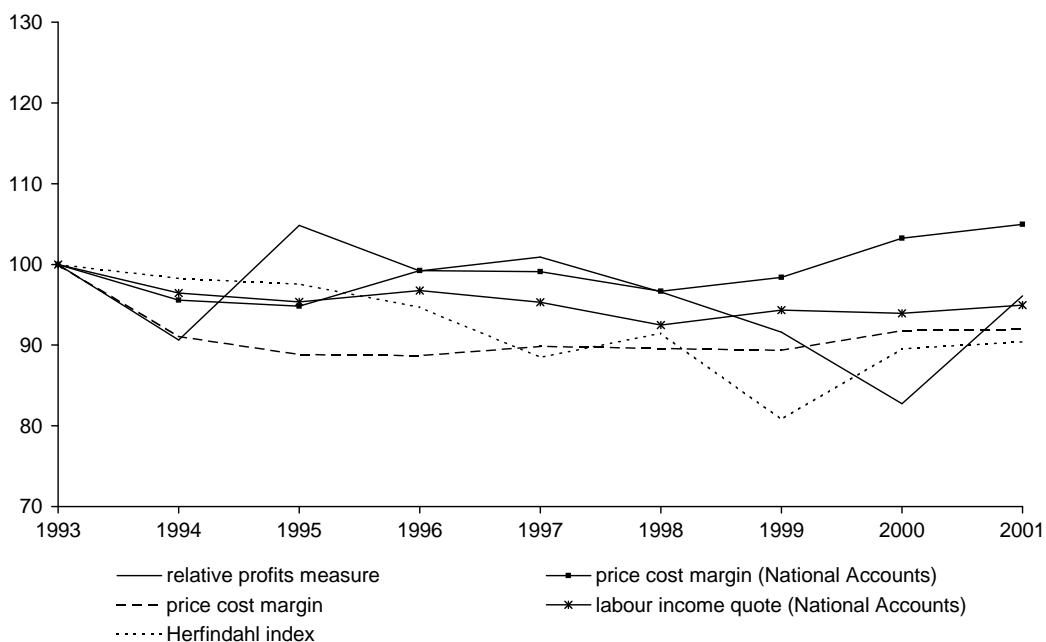
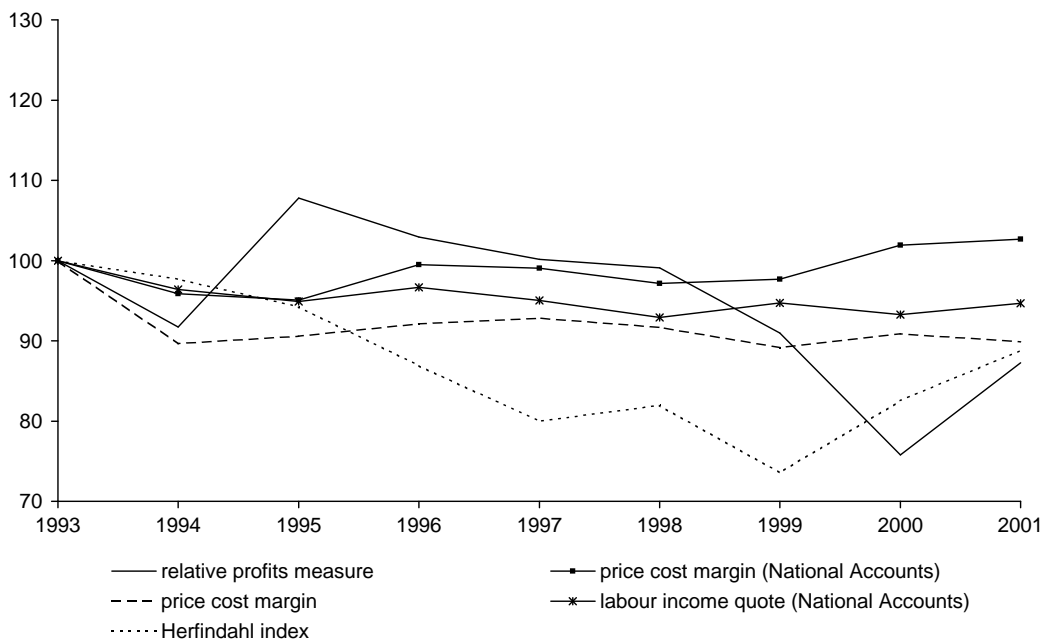


Figure 4.1 shows the competition development for each competition indicator over time. It presents an index (1993=100) for which an *increase* points to more competition (and vice versa). The opposite development of both price-cost margins signalled in table 4.1 is not entirely located in one particular year. Both indicators correspond largely over time, but the message is different at the end of the period. As their economic concepts are identical, the reason for this diverging pattern is likely related to measurement issues.

4.3.2 Results approach 2

The results for the second approach are in line with the first one. The same four competition indicators point to a decrease in competition for the Dutch market sector (see table 4.1, third column). In addition, the competition indicators derived from firm-level data all point to less competition. Again, the price-cost margin based on National Account data indicates a slight increase in competition. Figure 4.2 shows that the variation between the indicators is larger in case of approach 2 than approach 1 (see figure 4.1).

Figure 4.2 Competition Dutch market sector (1993=100): approach 2, 1993-2001



Competition growth according to within-industry component

The shift-share analysis also allows looking at the components of approach 2. This decomposition shows that the *within-industry component* corresponds closely to the results according to approach 1, except for the relative profits measure (see table 4.1, column 4). According to the within component, the relative profits measure increases in the period 1993-2001 suggesting fiercer competition in the Dutch market sector.

Competition fell due to the between-industry and cross components

Table 4.1 (fifth and sixth column) also reveals that shifts in the industrial structure from 1993-2001 have contributed to a decline in competition of the Dutch market sector for most indicators except for the labour-income ratio.

This result points to a shift towards industries with relatively low levels of competition. Also, the cross component mostly indicates that competition in the market sector has fallen, because competition especially declined in the fastest growing industries. Obviously, this statistical outcome does not take into account the determinants in this process. Still, if we assume fast growing industries and entry positively correlate than the results could indicate that the entry of firms in these has been insufficient to give sufficient countervailing power with regard to competition.

4.3.3 Overall conclusion approach 1 and 2

In conclusion, both approach 1 and 2 suggest that the intensity of competition in the Dutch market sector has probably slightly declined at the aggregated level from 1993 to 2001. This is partly due to a shift in the industrial structure to industries with less intense competition. Looking at both data sources, all measures derived from firm-level data point to less intense competition, whereas the indicators derived from the National Accounts contradict each other on the direction of competition change. The price-cost margin based on firm-level data and the price-cost margin based on National Account data disagree on the direction of the change in competition.

4.4 Manufacturing industry and services sector

4.4.1 Introduction

This section analyses competition growth at the sectoral level during 1993-2001, i.e. the manufacturing industry and the services sector. The main question we address here is whether competition differently developed in the manufacturing industry than in the services sector. In answering this question, we apply the same two approaches to aggregate competition results.

As discussed, part of the decline in competition in the Dutch market sector is related to shifts of the economy to industries with lower levels of competition. As our economy moves to a services economy, this finding indicates that the intensity of competition in the manufacturing industry is fiercer than in the services sector. Table 4.2 affirms this statement.

Table 4.2 Competition levels manufacturing industry and services sector, 1993^a

	Manufacturing	Services sector
	Market sector =100	
Firm-level data		
Relative profits measure	150	54
Price-cost margin	120	73
Herfindahl index	125	91

^a The (weighted) average indicators for the manufacturing sector and for the services sector are related to the (weighted) average for the market sector. Note that for the price-cost margin and the Herfindahl index the ratios are reversed, as a higher price-cost margin or Herfindahl index points to less competition.

4.4.2 Manufacturing industry

Table 4.3 presents the findings of both approaches for the Dutch manufacturing industry. Both for approach 1 and for approach 2, the competition measures indicate less competitive pressure in the manufacturing industry in 2001 than in 1993. The only exception is the price-cost margin

based on the National Accounts.³⁴ Again, the results of this competition indicator differ between both data sources.

Table 4.3 Trends competition growth manufacturing between 1993 and 2001

Conditions	Approach 1	Approach 2			
Structure manufacturing	Fixed to 1993	Flexible	Components		
		Total	Within-industry	Between- industry	Cross
Average percentage annual competition growth					
Firm-level data					
Relative profits measure	- 0.75	- 0.58	0.69	- 0.83	- 0.43
Price-cost margin	- 0.71	- 1.37	- 0.60	- 0.06	- 0.75
Herfindahl index	- 1.64	- 3.76	- 1.99	- 2.66	0.85
National Accounts					
Price-cost margin	0.75	0.47	0.80	- 0.39	0.13
Labour-income ratio	- 1.02	- 1.31	- 1.03	0.01	- 0.30

The price-cost margin also deviates with regard to the absolute number of industries (see table 4.4). Here, competition became fiercer in the majority of the manufacturing industries.

However, those industries are relatively small compared to those industries where competition became less intense. The share of the former was 35 percent, whereas the latter was 65 percent.

Table 4.4 Competition changes in manufacturing industry, 1994-2001

	Industries with fiercer competition		Industries with lower competition	
	Number of industries	% share ^a	Number of industries	% share ^a
Relative profits measure	23	47	38	53
Price-cost margin	42	35	19	65
Herfindahl index	19	82	42	18

^a I.e. the sum of output shares in 1993 of the industries in the manufacturing sector.

Services sector

In contrast to the findings for the Dutch manufacturing industry, the direction of competition in the services sector is ambiguous (see table 4.5). Again, the price-cost margin developed differently between both data sources. Moreover, the outcomes for both approaches do not entirely correspond. This finding suggests that shifts within the services sector and differences in the extent of competition could be considerable. Table 4.6 supports this statement, as the results in absolute terms do not correspond completely with the ones in table 4.5.

³⁴ Note that the within industry component from approach 2 for the relative profits measure differs from the fixed industry structure under approach 1. Apparently, gradual changes in the industrial structure cannot be neglected.

Table 4.5 Trends competition growth services sector between 1993 and 2001

Conditions	Approach 1	Approach 2			
Structure services sector	Fixed to 1993	Flexible	Components		
		Total	Within-industry	Between-industry	Cross
Average percentage annual competition growth					
Firm-level data					
Relative profits measure	0.49	0.50	- 0.09	0.18	0.45
Price-cost margin	- 0.81	- 0.65	0.02	- 0.26	- 0.44
Herfindahl index	- 0.52	0.08	- 0.65	1.87	- 1.09
National Accounts					
Price-cost margin	0.82	0.89	0.75	0.22	- 0.09
Labour-income ratio	- 0.33	- 0.28	- 0.32	0.11	- 0.07

Table 4.6 Competition changes in services sector according to the indicators, 1994-2001

	Industries with fiercer competition		Industries with lower competition	
	Number of industries	% share ^a	Number of industries	% share ^a
Relative profits measure	16	41	19	59
Price-cost margin	15	63	20	37
Herfindahl index	20	38	15	62

^a I.e. the sum of output shares in 1993 of the industries in the services sector.

4.5 Industry level

Finally, we present the results at the industry level and neglect aggregation issues. This analysis provides more detail whether competition intensified or became less intense economy-wide. As the focus of this memorandum is exploring the comprehensive firm-level data set, we limit this comparison to the three indicators based on firm-level data. Figure 4.3 shows the distributions of the growth rates of competition across industries for each indicator. Each bar represents the (trend) change in competition for an observed industry between 1993 and 2001.³⁵

Overall, the indicators do not suggest that competition decreased economy-wide. Instead, they show a wide variety in competition developments across industries. Although competition changes have been rather small in many industries, a considerable number of industries face a sharp rise or strong fall in competition. Figure 4.3 illustrates that in many industries the trend in competition change was not significant, particularly for the price-cost margin. Largely, this insignificance is because the indicator hardly changed over time.

³⁵ The percentage change of competition in each industry is the change of the estimated trend for the whole period 1993-2001 and not the observed change. The former provides a better impression of the structural development of competition, because it corrects for potential outliers in 1993 and 2001.

Figure 4.3 Distribution of competition changes across Dutch industries, 1994-2001

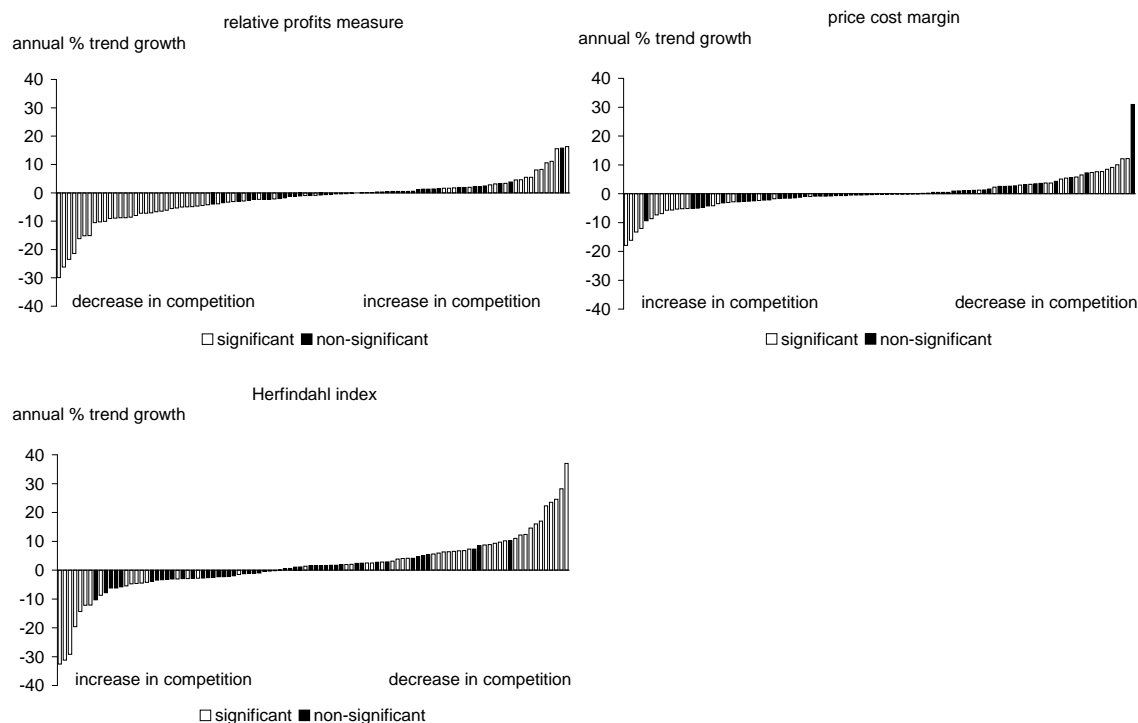


Table 4.7 makes these conclusions explicit by showing the number of industries where competition intensified respectively became less fierce. Although we conclude in section 4.3 that all the competition indicators derived from firm-level data point to less intense competition in the market sector, the table illustrates that those indicators are not completely in line in terms of number of industries. Competition declined in the majority of the industries according to the relative profits measure and the Herfindahl index. In contrast, the price-cost margin indicates that competition in most industries rose. As the market share of industries with fiercer competition is also higher than industries with lower competition, the latter industries experienced relatively larger changes in competition because aggregation over industries point to less competition.

Table 4.7 Changes competition Dutch market sector according to the indicators, 1994-2001^a

	Industries with fiercer competition		Industries with lower competition	
	Number of industries	% market share ^a	Number of industries	% market share ^a
Relative profits measure	41	49	59	51
Price-cost margin	58	53	42	47
Herfindahl index	43	56	57	44

^a I.e. the sum of market shares in 1993 of the industries in the market sector.

4.6 Conclusions

During 1993-2001, we do not find evidence that competition in the Dutch market sector increased economy-wide. In contrast most of the indicators point to a decrease in competition at the aggregated level. This conclusion holds for two approaches how to aggregate individual industry results. The first approach assumes that competition in the market sector entirely depend on the competition of each industry separately, using fixed weights to aggregate. Implicitly, we assume no product substitutability between industries. Hence, changes in the relative prices between industries due to competition do not affect the industrial structure. The second approach assumes that differences in competition intensities across industries may have real economic consequences. Now, products are to some extent substitutable. Changes in competition affect the relative prices between the industries. Consequently, the latter affects the industrial structure.

The data sources have an impact on the degree on competition development in the market sector. This finding most clearly appears in case of the price-cost margin. Competition declined if the price-cost margin is derived from firm-level data, whereas competition intensified if the price-cost margin is based on figures from the National Accounts.

Part of the decline in competition at the aggregated level is due to a shift in the industrial structure towards services industries with relatively lower levels of competition. At the sectoral level, most competition measures indicate that the extent of competition in manufacturing appears to be lower in 2001 than it was in 1993. The story is less clear-cut for the services sector.

At the industry level, the indicators do not suggest that competition increased economy-wide. Instead, industries show a wide variety in competition developments. Although competition changes have been rather small in many industries, a considerable number of industries experience a sharp rise or strong fall in competition.

5 Matching indicators by industry

The three indicators derived from firm-level data frequently contradict each other on the direction of change in competition at the industry level. In a bilateral comparison, the measures point in the same direction in half of all observed industries, whereas in a triple comparison the percentage shrinks to 25 percent. The mutual coherence between the indicators is more robust in the long term than in the short term. It looks as if the relative profits measure and the price-cost margin correlate the best.

5.1 Introduction

The main question of this chapter is to what extent the indicators agree on the competition changes per industry in the period 1993-2001. In chapter 4, we conclude that the competition indicators evolved to some extent in the same way at aggregated levels. Moreover, competition did not change considerably in a large number of industries. Chapter 4, however, did not match the indicators at the industry level. This will be done in this chapter. This chapter only employs the firm-level data, as this data source is rather new in this perspective and not earlier explored in this way.

We use a number of steps to answer the main question. Section 5.2 looks at the correlation of indicators across industries over time. We do that both for the whole period at large and year-by-year. The former (“over time”) analysis compares the average trend growth of indicators. This comparison highlights the long term mutual coherence between indicators on competition. The year-by-year perspective uses the correlation coefficient between two pairs of competition measures per year. This comparison provides information on the short term mutual coherence between the indicators ignoring time-specific effects. Section 5.3 compares the level of the indicators analysing the sign of the (linear) relationship between two indicators neglecting industry-specific effects. Next, we show for how many industries the three indicators fully agree in the direction of change in competition.

5.2 Correlation across industries over time

Period 1993-2001

There is limited coherence over the period 1993-2001, as each pair of indicators corresponds on the change in competition in about a half of all industries. Table 5.1 presents the number of industries where the indicators lead to a similar conclusion on the direction of competition change. The relative profits measure and the Herfindahl index are most in line with each other in terms of number of industries. The figures 5.1-5.3 make the difference between the indicators

more explicit. It plots the growth rates over the period 1994-2001 of the indicators pair wise for each industry.

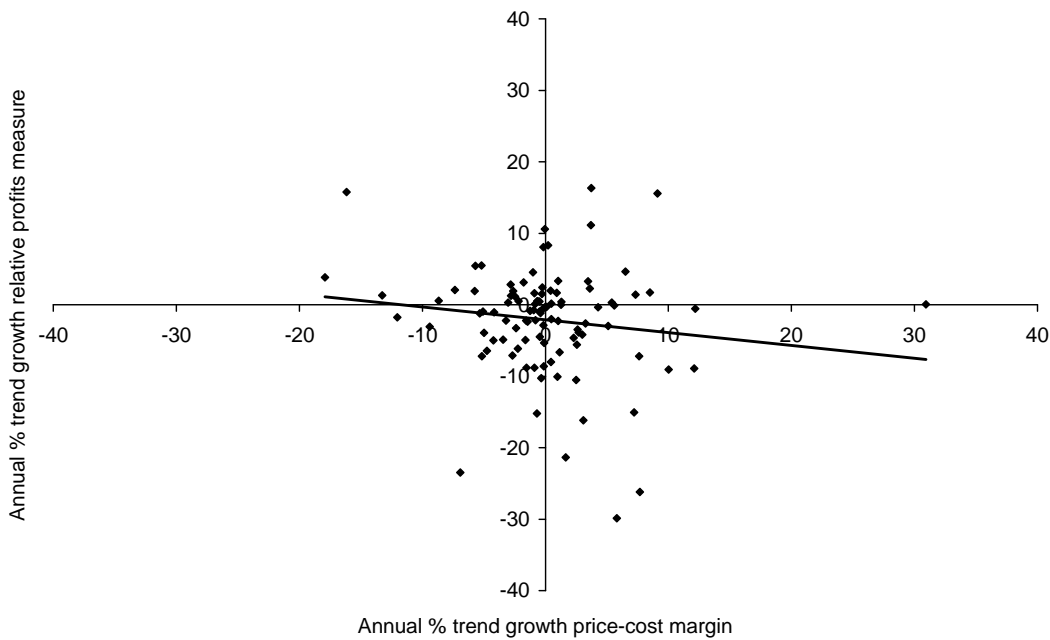
Table 5.1 Number of agreement across measures, 1993-2001^a

	Number of industries
Relative profits measure & price-cost margin	51
Relative profits measure & Herfindahl index	54
Price-cost margin & Herfindahl index	43

^a Total available industries is 100.

Figure 5.1 plots the average growth rates of the relative profits measure and the price-cost margin.

Figure 5.1 Changes price-cost margins and relative profits measures across Dutch industries, 1993-2001

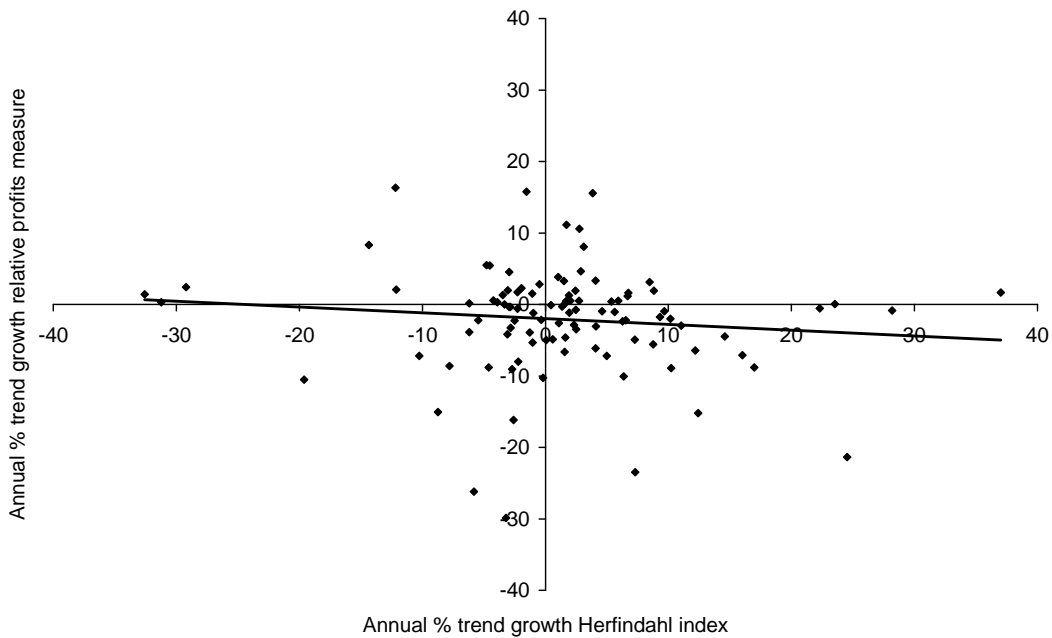


If the indicators would agree completely on the competition change by industry, then the figure should show a negative relationship as an increase in the price-cost margin and a decrease in the relative profits measure indicate weaker competition (and vice versa). Empirics affirm this negative relationship as the slope of the plotted regression line illustrates. Moreover, the indicators are insignificantly negative correlated. Nonetheless, as already illustrated in table 5.2, the indicators differ in the direction of competition for many industries.

Likewise, figure 5.2 plots the changes of the relative profits measure and the Herfindahl index for all observed industries. A higher relative profits measure and a lower Herfindahl index

suggest more competition (and vice versa). Hence, a negative correlation between both indicators is likely to be expected. Again, the two measures of competition agree to some extent according to the regression line.

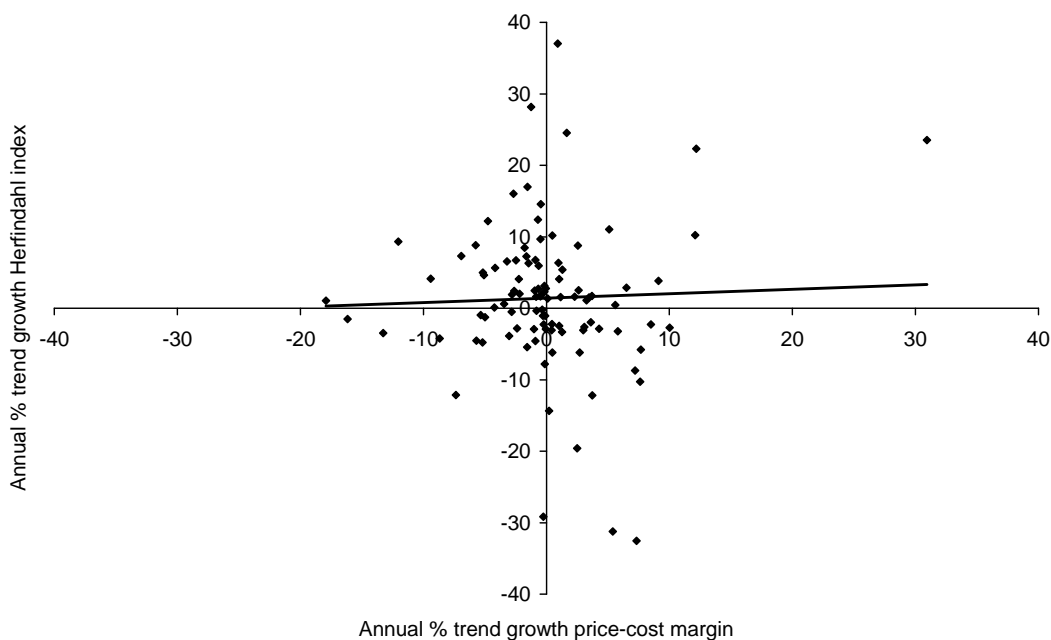
Figure 5.2 Change relative profits measure and Herfindahl index across Dutch industries, 1993-2001



Finally, figure 5.3 presents comparable results for the industry price-cost margin and the Herfindahl index. This time a positive correlation between both indicators occur over time, but it is not significant.³⁶ In fact, in most industries the price-cost margin and the Herfindahl index disagree on the change in competition (see also table 5.2).

³⁶ In fact, the positive but insignificant correlation is due to several outliers.

Figure 5.3 Changes price-cost margins and Herfindahl index across Dutch industries, 1993-2001



Year-by-year

Table 5.2 contains the number of industries where a year-by-year comparison of the (level of) indicators in the period 1993-2001 results in a significant correlation. Theoretically, the relative profits measure should correlate negatively with the two other indicators, while the price-cost margin should correlate positively with the Herfindahl index.

Table 5.2 Significant^a correlation between competition measures across industries over time, 1993-2001

	Total	Positive correlation	Negative correlation
	Number of industries		
Relative profits measure & price-cost margin	15	3	12
Relative profits measure & Herfindahl index	13	8	5
Price-cost margin & Herfindahl index	29	13	16

^a I.e. significant at the 10% significance level.

The table shows that the number of industries where the indicators significantly correlate using a year-by-year comparison is limited. In less than 30% of all (selected) industries, the correlation between the competition indicators is significant. If we also take the expected relationship between the indicators into account, then the results are even poorer.³⁷

³⁷ Compared to the analysis of the period 1993-2001, the mutual coherence in the change of competition at the industry level is not larger in the medium term than in the short term when insignificant results of the year-by-year comparison are taken into account as well.

5.3 Correlation between industries

Another way to examine the mutual coherence between competition indicators is to compare them between industries for each year (see table 5.3). To be precise, we analyse for each year what the (linear) relationship between two indicators is with respect to the levels of competition, neglecting industry specific effects.

Table 5.3 Significant^a correlation competition measures between industries per year, 1993-2001

	Total	Positive correlation	Negative correlation
	Number of years		
Relative profits measure & price-cost margin	9	0	9
Relative profits measure & Herfindahl index	4	4	0
Price-cost margin & Herfindahl index	0	0	0

^a I.e. significant at the 10% significance level.

As expected, the relative profits measure is negatively correlated with the price-cost margin across industries. For each year, we find significant results at the 10% level. The relative profits measure and the Herfindahl index are even positively correlated in four years, which contrasts with the general expectation of a negative relationship. Although we would expect a positive correlation between the Herfindahl index and the price-cost margin, this relationship is never significant for all observed years.

Comparable findings at the industry level for the UK

Boone et al. (2005) find similar results on the correlation between indicators, either over time or within a year. They also find that the relative profits measure and the price-cost margin are generally significantly correlated with the appropriate sign. Still there are many industries where both indicators are not or not appropriately correlated. Further, they also find that the Herfindahl index hardly correlates with the two other indicators.

Boone et al. (2005) investigated the coherence of the three indicators for 43 SIC 3-digit branches in the UK between 1986 and 1999 in a similar way as this memorandum. Their definitions of the Herfindahl index and the (industry) price-cost margin are the same as applied in this memorandum. However, their relative profits measure deviates from the one in this memorandum. It relates the (logarithm of) the firms' profits with their marginal costs:

$$\log \pi_i = \alpha^* - \beta^* c_i$$

So Boone et al. assume a non-linear relationship, while this memorandum assumes a linear relationship in logarithms or in percentage change of the profits and relative costs. Note that from an econometric point of view, taking relative variable or "non-relative" variables does not affect the outcome of the estimate relative profits measure (β or respectively β^*).

5.4 Complete agreement on change in competition

This section presents the industries for which competition increased respectively declined during 1993-2001 according to all three indicators.

Industries with an increase in competition

The three indicators only agree on intensified competition in 11 industries (see table 5.4). Most of these industries belong to the manufacturing sector. Table 5.4 also presents the correlations between the indicators over time. These correlations support the statement that indicators are less in line by a year-by-year comparison. Although the indicators agree the sign of the competition change over the period 1993-2001, the year-by-year development turns out to be frequently different because the sign of the correlation coefficient is not similar in all cases across industries.

Table 5.4 Year-by year correlation between indicators in industries with fiercer competition, 1993-2001

SIC code	Industry	Correlation between ^a		
		Relative profits measure & price-cost margin	Relative profits measure & Herfindahl index	Herfindahl index & price-cost margin
212	Manufacture of articles of paper and paperboard	0.355	- 0.023	0.077
243	Manufacture of paints, varnishes and similar coatings, printing ink and mastics	- 0.914 *	- 0.386	0.572
246	Manufacture of other chemical products	0.062	0.313	0.882 *
313	Manufacture of insulated wire and cable	- 0.400	- 0.392	0.722 *
343	Manufacture of parts and accessories for motor vehicles and their engines	- 0.430	0.301	0.551
366	Other manufacturing n.e.c.	0.493	0.340	0.784 *
455	Renting of construction or demolition equipment with operator	0.149	0.806 *	0.002
523	Retail sale of pharmaceutical and medical goods, cosmetic and toilet articles	- 0.061	- 0.030	0.023
526	Retail sale not in stores	- 0.734 *	0.408	- 0.572
620	Air transport	- 0.505	- 0.077	0.780 *
631	Cargo handling and storage	- 0.548	- 0.212	0.443

^a * Means significance at 10%-significance level.

Industries with a decrease in competition

For 13 industries, the three indicators all point to less competition during 1993-2001 (see table 5.5). Again, most of these industries belong to the manufacturing industry. Table 5.8 presents the correlations between the indicators. Once more, these correlations show that neither combination of indicators has a strong mutual coherence in the short run. The price cost-margin

and the Herfindahl index are most consistent in terms of the appropriate sign. However, the correlations are mainly not significant.

To wrap up, all indicators only agree in 25 percent of all industries. Still, this is more than just coincidence.³⁸ Without further investigation, it is not quite clear what the presented industries in table 5.4 and 5.5 have in common or what makes them different from other industries where indicators do not agree in sign.

Table 5.5 Year-by-year correlations of indicators in industries with lower competition, 1993-2001

SIC code	Industry	Correlation between ^a		
		Relative profits measure & price-cost margin	Relative profits measure & Herfindahl index	Price-cost margin & Herfindahl- index
152	Processing and preserving of fish and fish products	0.204	0.239	0.594 *
160	Manufacture of tobacco products	- 0.384	- 0.094	- 0.038
192	Manufacture of luggage, handbags and the like, saddlery and harness	0.553	0.539	0.675 *
203	Manufacture of builders' carpentry and joinery	- 0.213	- 0.150	0.681 *
281	Manufacture of structural metal products	0.059	- 0.113	0.412
282	Manufacture of tanks, metal containers, central heating radiators and boilers	0.004	- 0.292	0.440
316	Manufacture of other electrical equipment n.e.c.	0.020	0.019	0.366
331	Manufacture of medical and surgical equipment and orthopaedic appliances	- 0.352	- 0.363	0.928 *
354	Manufacture of motorcycles and bicycles	- 0.334	- 0.194	- 0.454
504	Sale, maintenance and repair of motorcycles and related parts and accessories	0.091	0.144	0.456
521	Retail sale in non-specialized stores	- 0.363	0.154	- 0.014
712	Renting of other transport equipment	0.082	- 0.279	0.735 *
723	Data processing	- 0.647 *	- 0.041	- 0.197

^a * Means significance at 10%-significance level.

5.5 Conclusions

This chapter analyses to what extent the indicators agree on competition changes per industry in the period 1993-2001. Based on firm-level data, we conclude that the indicators frequently contradict each other on the sign of the change in competition at the industry level. In a pair-wise comparison, the measures point in the same direction in half of all observed industries. All indicators only agree in 25 percent of all industries.

³⁸ This is 12.5 percent: $0,5 \cdot 0,5 \cdot 0,5$.

Combining all analyses, it looks as if the relative profits measure and the price-cost margin correlate the best, whereas the relative profits measure and the Herfindahl index correlate the worst.

6 Explaining differences between indicators

The observed differences in competition development between the indicators at the industry level can partly be traced back to differences in their economic concepts. In theory, more dispersion in efficiency among firms and higher price elasticity reduce the coherence between the indicators and the change in competition, while more firms would increase the coherence. Econometric and statistical tests provide some but mainly insignificant evidence to support these hypotheses for the indicators derived from firm-level data.

6.1 Introduction

From the previous chapter and chapter 4, we learn that competition indicators derived from firm-level data coincide to some extent both at the aggregated level and across industries of the Dutch market sector as well, but they also contradict frequently. In only 25% of all industries the three indicators agree on the change in competition between 1993 and 2003.

The latter finding does not to be surprising since the indicators are based on different economic concepts as discussed in chapter 3. Particularly, section 3.2 reveals that determinants of competitive changes might result in reallocation effects of market shares among firms within an industry. These reallocation effects may lead to contradictory signals of the competition development according to the indicators.

The aim of this section is to investigate to what extent the observed disagreement between the indicators can be traced back to differences in their economic concepts. In particular, we focus on determinants, which generate reallocation effects. In fact, reallocation effects might have been important in the period observed. A comparison of our regular (weighted) price-cost margin with an unweighted price-cost margin provides some sense for the importance of reallocation of market shares (see box). The measures differ in approximately 30 percent of all observations.

The structure of this chapter is as follows. Section 6.2 starts with the hypotheses based on the first three examples of chapter 3, viz. more dispersion in efficiency among firms (due to innovation), more product substitutability and more firms (due to lower entry barriers). The following section introduces the instrument to test the hypotheses and discusses the test results. Next, we switch to on an alternative statistical analysis focussing on the impact of the number of firms and firm dynamics on the contradiction between the indicators. Section 6.4 concludes.

Comparison price-cost margins points to reallocation effects

Hitherto, the analysis has used the weighted price-cost margin at the industry level, with the firms' (current) market shares as the weight of their individual price-cost margin. To know whether reallocation effects between firms are relevant, it is useful to compute an unweighted price-cost margin. The unweighted price-cost margin considers each firm equal, be it large or small, and is defined as $PCM = \frac{1}{n} \sum_i pcm_i$, with n the number of firms and pcm_i the individual price-cost margin of firm i . Hence, differences between both price-cost margins may point to reallocation effects.

The table compares the outcomes of the unweighted price-cost margin and the weighted price-cost margin on the change in competition. According to the weighted price-cost margin, competition intensified in the majority of industries competition, whereas the unweighted price-cost margin is slightly in favour of less intense competition. The table reveals that for 30% of all industries both measures do not agree on the changes in competition. In general, the divergence between both primarily occurs if the distribution of the market shares changes and reallocation effects emerge.

Comparison unweighted and weighted price-cost margin, 1993-2001			
Unweighted price-cost margin indicates	Weighted price-cost margin indicates		Total
	Increase in competition	Decrease in competition	
	Number of industries		
Increase in competition	38	11	49
Decrease in competition	20	31	51
Total	58	42	100

6.2 Explaining differences indicators using a Probit-test

6.2.1 Three hypotheses

More dispersion in efficiency reduces correlation between indicators

In theory, more dispersion in efficiency among firms in a market leads to a rise in competition according to the relative profits measure, and induces ambiguous predictions for the Herfindahl index and the price-cost margin (see table 3.1). Higher dispersion in efficiency enhances the reallocation effects of market shares. In practice, it raises the probability that indicators disagree on the competition change.

In order to investigate the impact of efficiency differences on the indicators, we approximate the dispersion in efficiency levels by the standard deviation of the average variable costs across the firms per industry in 1993.³⁹ The *change* in the standard deviation of the average variable

³⁹ Unfortunately, we lack appropriate data on innovation to test the impact of innovation on the coherence between indicators.

costs approximates changes in the efficiency dispersion. Our hypothesis is that competition indicators will more likely contradict each other on the development of competition if industries differ in terms of dispersion levels and experience an increase in those levels.

More product substitutability reduces correlation between indicators

In theory, a higher level of product substitutability induces more reallocation effects. More product substitutability leads to a rise in competition according to the relative profits measure, less competition according to the Herfindahl index, while the industry price-cost margin is ambiguous as table 3.1 shows. Hence, the hypothesis is that more product substitutability reduces the agreement between the indicators on competition change.

For the empirical test, we use the price elasticity of total demand per industry as approximation of the non-observed substitution elasticity. The overall price elasticity of each industry is calculated as the ratio of the price-cost margin and the Herfindahl index.⁴⁰

More firms in an industry increases correlation between indicators

The theory predicts that all three indicators should point to intensified competition if the number of firms on a market increased due to lower fixed entry costs. Thus, the hypothesis is that the indicators match if the number of firms rises in an industry.

For the empirical test, we use the number of firms per industry as approximation of the extent of entry barriers. Moreover, reallocation effects become more sizeable as the industry consists of fewer firms, which will be reflected by the number of firms in 1993.

6.2.2 Probit test

The hypotheses are tested simultaneously with a Probit model. This model compares the indicators pair-wise at the industry level, and correlates each determinant with the probability of agreement of the indicators. The formal model yields for each industry j as follows:

$$C_j = 1 \text{ if } C_j^* = \alpha + \sum_k \beta_k S_{jk} + \sum_k \gamma_k \Delta S_{jk} > 0$$

$$C_j = 0 \text{ otherwise}$$

where $C_j = 1$ if two competition indicators agree in signalling the direction of change in competition, and $C_j = 0$ if the two competition indicators do not agree. Put it informally,

⁴⁰ If we assume that firms charge similar prices and do not respond directly to competitor's output (as in Cournot competition), then the price elasticity in consumer demand is equal to the ratio of the Herfindahl index and the industry price-cost margin. This assertion can be derived from the relation between the industry price-cost margin and the Herfindahl index (see Cabral, 2000).

C_j^* denotes the probability that the competition indicators agree. Observations of C_j are derived from the average trends of each indicator between 1993 and 2001. S_{jk} represents the level in 1993 and ΔS_{jk} the change over the period 1993-2001 of the observable variable of determinant k . We include the change of the explanatory variable to catch the growth in differences between firms that enhance the reallocation effects. We also employ the initial level of each determinant to catch the reallocation effects due to initial differences in efficiency level between firms.

6.2.3 Test results⁴¹

Table 6.1 presents the estimation results of the Probit model. These overall results point out whether the three hypotheses hold for each pair of indicators, and thus to what extent the model can explain the agreement between the indicators on the changes in competition at the industry level.

In general, the results are very mixed across the indicators. The model partly explains why the indicators may disagree, particularly for the disagreements between the relative profits measure and the price-cost margin. Some coefficients have the right sign, but most of them are not significant, even at the 10% confidence level (i.e. 1.99).⁴² Further, the model does not support the hypothesis that the amount of firms and relatively more entry would improve the probability of coherence in competition change between the indicators at the industry level.

Relative profits measure and price-cost margin

All coefficients of the determinants have the right sign and explain to some extent the disagreement between the relative profits measure and the price-cost margin, except for the change in the number of firms. Still, the coefficients are statistically insignificant.

Relative profits measure and Herfindahl index

The determinants hardly explain why the relative profits measure and the Herfindahl index disagree. Only the result for the price elasticity level is in line with the theoretical expectations.

Herfindahl index and price-cost margin

The level and change in the dispersion of efficiency levels, and higher price elasticity can partly explain the disagreement between the Herfindahl index and the price-cost margin. All other determinants have the opposite sign in explaining differences between both indicators. Again, the coefficients are statistically insignificant.

⁴¹ The appendix presents the results of the Probit test for each hypothesis separately.

⁴² The log likelihood signals the goodness of fit of the Probit model: a less negative Log likelihood points to a better fit. So a higher log likelihood of the Probit test suggest that the hypotheses can better explain the disagreement between the indicators. In that case, the results for the relative profits measure and the Herfindahl index appears to be the best.

Table 6.1 Impact of determinants on coherence between indicators

	Expected sign	Estimated parameter	t-values
Relative profits measure versus price-cost margin			
Intercept		0.661	1.208
Level of dispersion in 1993	–	– 3.304	– 0.880
Change of dispersion between 1994 and 2001	–	– 0.075	– 1.965
Elasticity level in 1993	–	– 0.068	– 0.576
Elasticity change between 1994 and 2001	–	– 0.015	– 0.982
Number of firms in 1993 ^a	+	0.194	.
Change in number of firms between 1994 and 2001	+	– 0.038	– 0.947
Log likelihood		– 55.4	
Number of observations		85	
Relative profits measure versus Herfindahl index			
Intercept		– 0.697	– 1.090
Level of dispersion in 1993	–	11.080	2.274
Change of dispersion between 1994 and 2001	–	0.082	1.704
Elasticity level in 1993	–	– 0.432	– 1.744
Elasticity change between 1994 and 2001	–	0.036	2.057
Number of firms in 1993 ^a	+	– 0.560	.
Change in number of firms between 1994 and 2001	+	– 0.139	– 2.602
Log likelihood		– 46.7	
Number of observations		83	
Herfindahl index versus price-cost margin			
Intercept		0.184	0.321
Level of dispersion in 1993	–	– 0.557	– 0.136
Change of dispersion between 1994 and 2001	–	– 0.056	– 1.244
Elasticity level in 1993	–	0.245	1.321
Elasticity change between 1994 and 2001	–	– 0.034	– 1.824
Number of firms in 1993 ^a	+	– 0.627	.
Change in number of firms between 1994 and 2001	+	– 0.043	– 0.976
Log likelihood		– 48.9	
Number of observations		83	

^a Estimated parameter (and standard error) multiplied by 10000, T-values are too small to be presented.

6.3 Exploration of number of firms

Hypothesis

The findings of the Probit-model does not support the hypothesis that the amount of firms and relatively more entry would improve the probability of coherence in competition change between the indicators at the industry level. As an extension of these findings, this section investigates the impact of the number of firms and net entry by reclassifying the industries in three categories according to their number of firms. The hypothesis is that the competition

indicators agree more on competition change if industries consist of more firms because then the reallocation effects are presumably smaller as discussed in section 3.

Impact of number of firms

To test whether the number of firms has an impact on the agreement, we classify the industries along the number of firms per industry. Out of the 100 industries, there are 17 industries with less than 150 firms, 38 industries with a medium number of firms, and 45 industries with more than thousand firms (see table 6.2).

One conclusion becomes apparent with respect to the consistency between the competition measures if the amount of industries is taken as indicator whether competition has increased. These measures only agree on the change in competition for industries with large numbers of firms. Here, all indicators suggest that competition became less intense in the majority of these industries.

Table 6.2 Changes competition market sector, by number of firms per industry, 1993-2001

	Fiercer	Lower
	Number of industries	
Small number of firms (0-150)^a		
Relative profits measure	7	10
Price-cost margin	11	6
Herfindahl index	8	9
Medium number of firms (151-1000)^b		
Relative profits measure	14	24
Price-cost margin	26	12
Herfindahl index	13	25
Large number of firms (>1000)^c		
Relative profits measure	20	25
Price-cost margin	21	24
Herfindahl index	22	23

^a Industries with on average 0 to 150 firms in total population.

^b Industries with on average 151 to 1000 firms in total population.

^c Industries with on average more than 1000 firms in total population.

Classification of industries based on data of CBS general firm register (ABR).

Following the classification of industries along the number of firms, table 6.3 presents the correlations in a pair-wise comparison.⁴³ It shows the percentage of industries per size class with a significant correlation between two indicators over time per industry.

⁴³ I.e. the year- by-year correlation between two indicators.

Again, it is expected that the extent of the correlation be positively related with the number of firms if we assume that the reallocation effects are smaller and hence the mutual coherence between the indicators increases. The empirics support this hypothesis to some extent as in most cases the percentage of total number of industries is highest for the group with large number of firms. Particularly, the correlation between the price-cost margin and the Herfindahl index is relatively high for this group.

Table 6.3 Correlation between indicators by number of firms per industry, 1993-2001

	Significant ^a	Significant ^a and agreement on competition ^b
	% of total number of industries	
Small number of firms (0-150)^c		
Relative profits measure & price-cost margin	11.8	5.9
Relative profits measure & Herfindahl index	17.6	0.0
Price-cost margin & Herfindahl index	11.8	5.9
Medium number of firms (151-1000)^d		
Relative profits measure & price-cost margin	13.2	7.9
Relative profits measure & Herfindahl index	2.6	0.0
Price-cost margin & Herfindahl index	31.6	10.5
Large number of firms (>1000)^e		
Relative profits measure & price-cost margin	17.8	6.7
Relative profits measure & Herfindahl index	20.0	17.8
Price-cost margin & Herfindahl index	33.3	28.9

^a Significance at 10%-significance level.

^b I.e. negative correlation between relative profits measure and Herfindahl index, negative correlation between relative profits measure and price-cost margin, and positive correlation between Herfindahl index and price-cost margin

^c Industries with on average 0 to 150 firms in total population.

^d Industries with on average 151 to 1000 firms in total population.

^e Industries with on average more than 1000 firms in total population.

Classification of industries based on data of CBS general firm register (ABR).

Impact of net entry

We also focus on changes in the number of firms or net entry per industry. In theory, the three indicators should point to an increase in competition as entry barriers decline and the number of firms increases (see chapter 3). This should induce a high significance of the correlation between indicators over time. On the other hand, the relation between exit and competition is less clear-cut. The observation of exit can indicate either weaker competition or intensified competition. The latter is caused by more aggressive interaction inducing shifts in market shares then the competition indicators register this situation differently.

Table 6.4 presents the results of the coherence between the indicators in case of changes in the number of firms. The table illustrates that the mutual coherence between two indicators is higher with respect to industries with an increasing number of firms.

Table 6.4 Changes number of firms per industry: correlation across industries over time, 1993-2001

	Increasing number of firms		Decreasing number of firms	
	Consensus on competition	Consensus on competition and significant ^a	Consensus on competition	Consensus on competition and significant ^a
	% share of industries with increasing or decreasing number of firms			
Relative profits measure & price-cost margin	32.6	4.7	15.1	2.3
Relative profits measure & Herfindahl index	36.0	7.0	17.4	1.2
Price-cost margin & Herfindahl index	40.7	11.6	15.1	4.7

^a Significance at 10%-significane level.

Data on the number of firms based on CBS general firm register (ABR).

Comparison with the Probit test

The correlation results above reveal that the competition measures tend to agree more on competition for industries with large numbers of firms. Moreover, the coherence between indicators is larger for industries with net entry compared to net exit. Hence, these two observations do not reject the hypothesis that the indicators will more likely agree on competition for industries with many firms. The Probit test of section 6.2, however, suggests that the number of firms has statistically no impact on the agreement of indicators. Net entry even tends to *reduce* the agreement between the competition measures. Consequently, the two types of analysis are not in line with each other regarding the impact of the number of firms and net entry.

6.4 Conclusions

According to theory, competition indicators may diverge on changes in competition because of reallocation in output (reallocation effects) or exit of inefficient firms (selection effect). Following these theoretical notions, we put to a test the hypotheses that more dispersion in efficiency levels and higher price elasticity should reduce the agreement between indicators on the change in competition, whereas more firms should improve their mutual coherence.

We find some but insignificant explanations why the indicators disagree. Using a Probit-model, this model provides weak support for the hypothesis on the dispersion of efficiency and on price elasticity, particularly for the disagreements between the relative profits measure and the price-cost margin. However, these explanations are not robust as the estimated parameters are mostly

insignificant. Further, the model does not support the hypothesis that the amount of firms and more entry would improve the probability of agreement between the indicators on a change in competition at the industry level.

By reclassifying the industries into three categories based on the number of firms, we find some support for the assertion that the number of firms has a positive impact on the agreement between the indicators on competition. Moreover, the coherence between indicators is larger for industries with net entry compared to net exit.

We conclude that the Probit test and the alternative statistical analysis can partly trace back the opposite competition developments of the indicators to differences in their economic concepts.

7 Conclusions

The empirical indicators do not suggest that competition increased economy-wide over the period 1993-2001. All show that competition changes have been rather small in many industries, but a considerable number of industries experience a sharp rise or strong fall in competition. Nonetheless, the indicators frequently contradict each other on the change in competition at the industry level. The development of competition and differences between the indicators are puzzles that challenge further economic research. The puzzling outcomes also imply that policy makers should be careful to draw conclusions based on only one competition indicator, as they can only be used as thermometers. An adequate assessment on competition development needs additional information.

7.1 Conclusions from analysis

No increase in competition

In this memorandum we investigated the key question: *How has competition changed across Dutch industries between 1993 and 2001?* In that respect we applied four indicators to measure developments in competition on three levels of aggregation.

The four indicators do not suggest that competition increased economy-wide from 1993 to 2001. At the aggregated level, the intensity of competition in the Dutch market sector has probably slightly declined. This is only partly due to a shift in the industrial structure to services industries with less intense competition. Neglecting changes in this structure, the course of competition is less clear-cut at the industry level.

At the sectoral level, most competition measures indicate that the extent of competition in manufacturing appears to be lower in 2001 than it was in 1993. The story is less clear-cut for the services sector.

At the industry level, we can only use the indicators based on firm-level data, i.e. the relative profits measure, price-cost margin and the Herfindahl index. These indicators show a wide variety in competition developments across industries. Although competition changes have been rather small in many industries, a considerable number of industries experience a sharp rise or strong fall in competition.

Contradicting indications at the industry level

The three indicators based on firm-level data frequently contradict each other on the change in competition at the industry level, even though they seem to be consistent at higher levels of aggregation. For any combination of two indicators, the indicators point in the same direction in half of all observed industries. When combining all three indicators, they agree only for a quarter of all industries. Combining all statistical tests, it looks as if the relative profits measure and the

price-cost margin correlate the best, whereas the relative profits measure and the Herfindahl index correlate the worst.

These differences can only partly be traced back to differences in their economic concepts. In theory, these three indicators may not agree on the direction of change in competition, if reallocation of market shares from inefficient to efficient firms occurs or inefficient firms are forced to leave the market (selection effect). More particularly, more dispersion in efficiency among firms and higher price elasticity would reduce the coherence between the indicators and the change in competition, while more firms would increase the coherence. Probit tests provide some but mainly insignificant evidence to support these hypotheses for the indicators derived from firm-level data. But by reclassifying industries according to their number of firms, we yet find some support for the assertion that the number of firms has a positive impact on the correlation between the competition indicators.

7.2 Puzzles and challenges for further research

So, according to most indicators, competition did not increase both at the aggregated level and across a wide range of industries of the Dutch market sector in the period 1993-2001. These findings are puzzling in light of regulatory reforms and competition policies designed to enhance competitive pressure among firms in the period observed. Additionally, the competition indicators differ frequently with respect to the direction of competition change when compared at the industry level. Both the development of competition as well as the differences between the indicators at the industry levels are puzzles that challenge further economic research on at least three issues of its determinants and data sources:

Determinants of competition

It is a challenge to explain why competition did not increase in many industries. Moreover, we find a large variety in competition development across industries. What reasons explain these developments? Actually, Creusen et al. (2006) endeavour to explain competition using a model relating competition to a number of determinants at the industry level for the period 1993-2001 (see box).

The explanation of competition development during 1993-2001

The CPB Document 'Competition in Dutch market sector: A preliminary analysis of the period 1993-2001' (Creusen et al., 2006) extends this memorandum. It explains the competition development at the industry level according to the relative profits measure and the industry price-cost margin using several determinants such as entry and exit of firms, changes in market demand and regulation.

The main conclusions of this document are that the competition policies since the 1990s probably have enhanced competition during 1993-2001. However, it is likely that other determinants had offset the policy effects. The foremost counteracting determinant was the strong economic growth during the second half of the 1990s. It enabled incumbent firms to raise their profit margins without being sufficiently thwarted by existing competitors or by new entrants driving profits down to normal levels.

Exploring differences between indicators

As showed in the previous chapter, empirical tests partly support the differences in economic concepts between the indicators. Nonetheless, the puzzle is not sufficiently resolved yet.

Moreover, all indicators are to some extent biased because the available data do not fully fit the needs for good measurement. Particularly, defining the relevant market is a notorious problem, mostly for the Herfindahl index. The relative profits measure and the price-cost margin, however, can be biased as marginal costs are simply approximated by average variable costs.

In that respect, a case study of a particular industry is an interesting way to explore the puzzling differences in concepts and the statistical shortcomings. So the challenges to be further taken into account are as follows:

- Improve understanding of the determinants that induces reallocation effects;
- Improve the approximation of marginal costs (see e.g. Bikker and van Leuvensteijn, 2006);
- Improve delineating the relevant market. For instance, select an industry where the available data plausibly fit the dimensions of the market the best.

Particularly, the first is a huge challenge. Reallocation of output and/or shifts in profits to efficient firms may either point to positive or negative developments in competition. Shifts in market shares and profits can point to intensified competition, as more competition rewards efficient firms for exploiting their competitive advantage. On the other hand, firms may also attain unwarranted market shares and profits by collusion or abuse of their dominant position.

Exploring differences between data sources

This memorandum explores two data sources: firm-level data and National Account data. It shows that the direction of competition change may depend on the data source, even when the same indicator has been applied. Actually, the price-cost margin derived from the firm-level

data points to intensified competition at the aggregated level over time, whereas the counterfactual points to less competitive pressure.

As already initiated by Statistics Netherlands itself, it is a challenge to explore these kind of differences between both data sources. Using an integrating framework, the figures of the National Accounts come from various aggregated micro level sources. These aggregated figures reflect methods and procedures applied to integrate different sources. The results can differ from weighted aggregates from one particular source. Analysing those differences may improve both firm-level data and National Account data.

7.3 Implications for policy makers

All indicators have shortcomings and are only thermometers

The first implication is that all applied competition indicators have their (theoretical) weaknesses. Not every aspect of competition seems to be fully accountable by the indicators. Particularly, the behaviour of firms, for instance, in terms of collusion or price discrimination, is very difficult to get under control in empirics.

To counteract these theoretical and statistical shortcomings it is to be preferred to use more indicators at once to get an impression of competition issues.

The competition measures act only as thermometers. Each indicator sheds some light on the background of competition. However, monitoring and evaluating the extent of competition require additional information on the determinants that could have had an effect on competition. Changes in competition may be due to changes in institutional settings, but other determinants such as business cycle, consumer behaviour may affect the extent of competition as well.

Trade-off between accurate monitoring and administrative burden

To some extent a trade-off arises between the administrative burden for firms and the aim to analyse and monitor competition. On the one hand, policy wants to reduce the administrative burden of legislation and regulation for firms, particularly for small and medium sized firms. On the other hand, policy aims to stimulate competition and wants to have the opportunity to monitor and to evaluate their competition measures.

As this document shows, these types of analyses require detailed information. Although Dutch firm-level surveys of Statistics Netherlands contain a tremendous amount of interesting information, additional information is indispensable if one wants to get a grip on the

competitive behaviour of firms. Particularly, information on firm-level prices and product differentiation is needed.⁴⁴

This research was explicitly confronted with the borders of analysing firm-level data for the Netherlands. Due to cutback in samples and other changes, the availability and quality of these types of data have been substantially under pressure. Moreover, confidentiality sometimes forbids researchers to examine certain industries due to (threshold) restrictions of Statistics Netherlands. These unobservable industries may include industries that would be very interesting from a competitive point of view.

⁴⁴ Note also that e.g. the relative profits measure does not explicitly take into account issues as collusion, mergers, predation and first mover advantages. Information on these issues should also be collected to assess the intensity of competition in a market.

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Appendix A Omitted data

Firm-level data

Competition growth of the market sector based on firm-level data is computed with 100 out of the 119 industries in the database. We had to delete 19 industries due to one of the following reasons:

- Industries for which the relative profits measure is negative in at least one year as a negative relative profits measure is not defined in theory.
- Post, telecommunication and 'other services', respectively SBI codes 641, 642 and 930. These industries experiences implausible large shocks in the Herfindahl-index.
- Car garages and car dealers (SBI code 501). Here, we encountered probably a statistical error in combination with large weight of the price-cost margin.

National Account data

Competition growth of the market sector based on the National Accounts is computed with 68 out of the 72 industries that match the firm-level dataset. The four industries that have been deleted are public personal transport (SBI 601, 602 excl. 6024), research and development (SBI 73), dairy products (SBI 155), shipbuilding (SBI 351). Those industries experienced either a negative price-cost margin or an implausible large shock in the price-cost margin in a particular year.

Appendix B Assessment of correlations

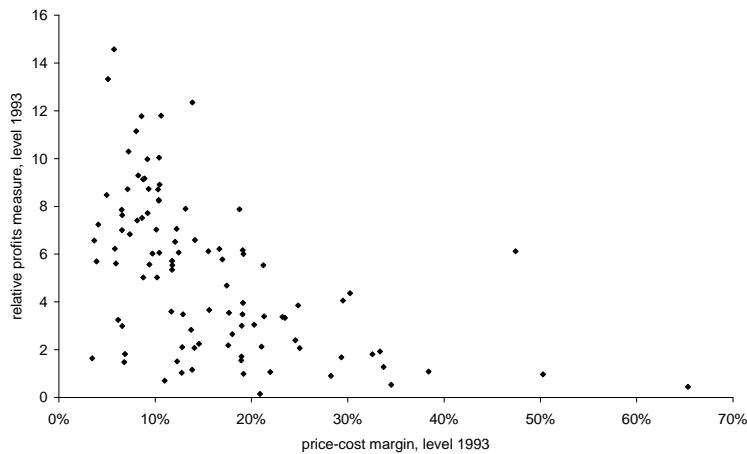
The correlation coefficient between indicators is measured as:

$$correlation = \frac{\sum_t (x_t - \bar{x})(y_t - \bar{y})}{\sqrt{\sum_t (x_t - \bar{x})^2} \sqrt{\sum_t (y_t - \bar{y})^2}}$$

with x_t , y_t a pair of two indicators in year t , and \bar{x} , \bar{y} the average of two indicators over time (i.e. for the period 1993-2001). It indicates whether a linear relationship exists between two variables. If the size of correlation is low, it only suggests that this is absent.

The approach of linearity between the indicators may need reconsideration, as the relation between the relative profits measure and the price-cost margin, for instance, seems to be far from linear (see figure below). Inverting the results of the relative profits measure into logs improves the correlation coefficient and its significance. The table presents the between industry results for the period 1993-2001.

Relative profits measure versus the price-cost margin, 1993



Between industry correlations, 1993-2001

	Relative profits measure & price-cost margin		Relative profits measure & Herfindahl index		Price-cost margin & Herfindahl index	
	Correlation	Significance ^a	Correlation	Significance ^a	Correlation	Significance ^a
1993	- 0.515	5.953*	0.097	0.963	0.110	1.095
1994	- 0.484	5.478*	0.048	0.473	0.096	0.958
1995	- 0.447	4.948*	0.285	2.946*	0.021	0.213
1996	- 0.563	6.741*	0.292	3.022*	- 0.036	0.355
1997	- 0.493	5.609*	0.124	1.232	0.030	0.300
1998	- 0.505	5.788*	0.108	1.077	0.018	0.176
1999	- 0.459	5.113*	0.087	0.862	0.072	0.717
2000	- 0.498	5.690*	0.332	3.483*	- 0.125	1.248
2001	- 0.474	5.332*	0.323	3.375*	- 0.038	0.375

^a Significance measured by t-value; * means significant at 10% significance level.
