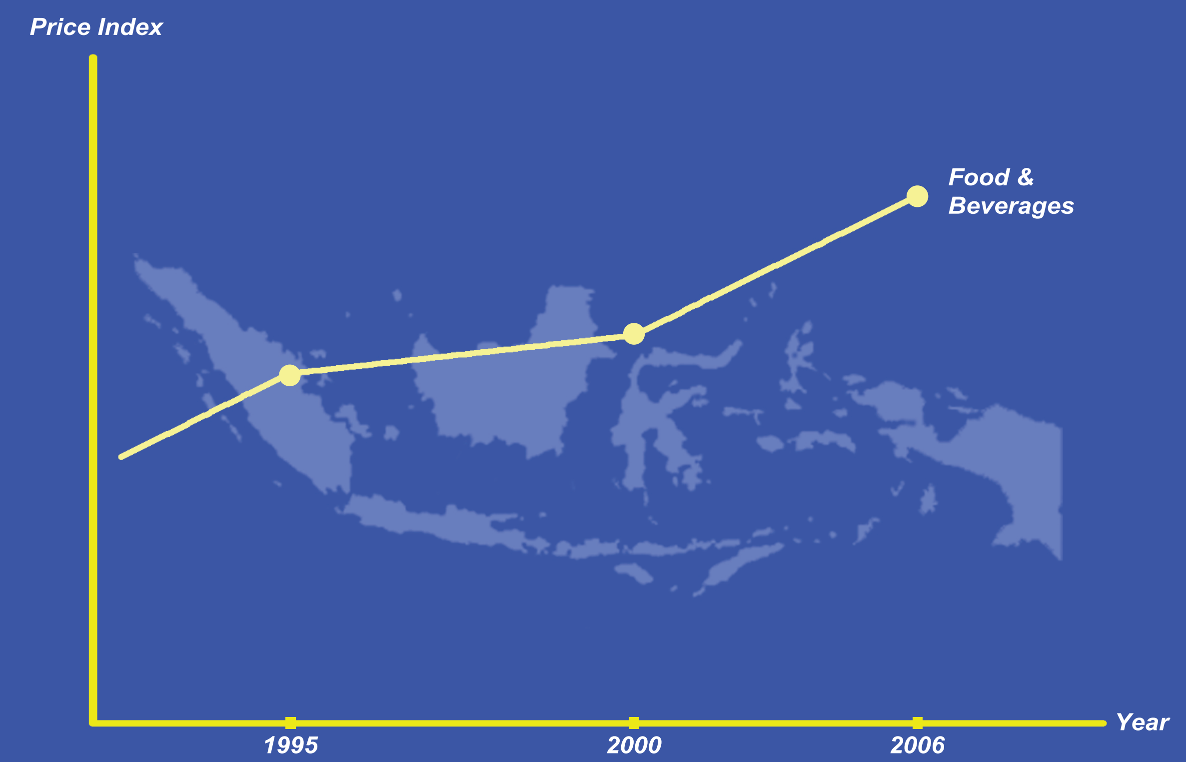
Market Structure, Price Rigidity, and Performance in the Indonesian Food and Beverages Industry



Maman Setiawan

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Market Structure, Price Rigidity, and Performance in the Indonesian Food and Beverages Industry

Maman Setiawan

Thesis
Submitted in fulfillment of the requirements for the degree of doctor
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Abstract

The Indonesian food and beverages industry contributes significantly to the Indonesian GDP and is an important provider of employment. However, this industry is characterized by high industrial concentration which may affect pricing and performance. The objective of this thesis is to examine market structure, price rigidity, and performance as well as their relationship in the Indonesian food and beverages industry. To investigate the relationship between market structure, price rigidity, and performance, this research uses two main frameworks: Structure-Conduct-Performance (SCP) and new empirical industrial organization (NEIO).

This thesis uses firm-level (establishment) data of 59 subsectors of the food and beverages industry sourced from the manufacturing survey of the Bureau of Central Statistics (BPS) over the period 1995-2006. Econometric methods and Data Envelopment Analysis (DEA) are used to address the overall objective.

Empirical results show that industrial concentration converges to the same value across subsectors in the long run. Seven years after the introduction of the competition law in 1999, industrial concentration and price-cost margin are still high. Industrial concentration has a positive effect on the price-cost margin. Besides stopping the upward trend of the price-cost margin, the introduction of the 1999 competition law reduced the effect of industrial concentration on the price-cost margin. The results also suggest that there is only a one-way relationship between industrial concentration and technical efficiency with industrial concentration affecting technical efficiency negatively. Furthermore, this thesis finds evidence that high industrial concentration increases price flexibility with the speed of price adjustment being higher when costs go up than down in the concentrated subsectors. Finally, the results show that there is a simultaneous relationship between industrial concentration, price rigidity, technical efficiency, and price-cost margin. A bi-directional relationship between industrial concentration and price-cost margin was found.

Keywords: industrial concentration, price rigidity, technical efficiency, price-cost margin, Structure-Conduct-Performance (SCP), new empirical industrial organization (NEIO), Indonesian food and beverages industry, Data Envelopment Analysis (DEA), system of equations

Preface

Undertaking a PhD program at Wageningen University has been a very worthwhile journey in my life and the completion of this PhD thesis has been made possible due to the contribution and support of many individuals.

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This thesis is dedicated to my late father, H. Osin (1953-2007).

Wageningen, November 2012

Maman Setiawan

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Chapter 1

General Introduction

Maman Setiawan

Business Economic Group, Wageningen University and Faculty of Economics and Business, University of Padjadjaran

1.1 Background

The food and beverages industry in Indonesia is one of the country’s most important economic sectors. This industry has a large share in the Indonesian gross domestic product (GDP) and total employment. Data from the Indonesian Bureau of Central Statistics reveal that the output of this sector accounted for about 7% of the GDP and the sector absorbed about 23% of total employment in the Indonesian manufacturing industry in 2006. Furthermore, more than 50 per cent of the Indonesian household income is spent, on average, on food and beverages. Also, the Indonesian government pays much attention to the industry, since food and beverages products are among the major drivers of inflation in Indonesia.

The Indonesian food and beverages industry is highly concentrated (see Bird, 1999) with only a few firms dominating the markets for food and beverage products. This dominance creates the conditions for exercising market power and enabling a few firms to affect the price to enjoy high price-cost margins. This has the potential of reducing consumer welfare by transferring consumer surplus to the firms, but more importantly, it could cause a welfare loss (deadweight loss) to the economy as a whole.

Furthermore, the high industrial concentration in the food and beverages industry is relatively persistent for various subsectors (see Bird, 1999). This persistence suggests that market dominance could worsen the welfare loss in the long term. The persistence of high industrial concentration may be caused by anti-competitive practices such as collusive behaviour and formation of trusts. This is, because prior to the economic reform in 1999, the Indonesian economy was characterized by many distortions such as monopolies that were put in place by the government. The introduction of the competition law in 1999 may have affected industrial concentration because it could break anti-competitive practices in the industry. Therefore, it is expected that the trend of industrial concentration in the food and beverages sectors could converge across subsectors, with some highly concentrated subsectors shifting to a lower industrial concentration. For policy makers, it is important to know whether the industrial policies such as the 1999 competition law have been effective in reducing industrial concentration and the price-cost margin in the industry.

Firms operating in the industry with high concentration may exercise market power to increase or maintain their price-cost margin. For example, a few leading firms in a highly concentrated industry can maintain their price-cost margin by responding more slowly to cost decreases (downward rigidity) rather than cost increases (upward flexibility). Because of such rigidity, the equilibrium price tends to be much higher than the cost compared to the case where price adjusts symmetrically to increases and reductions in cost. This in turn leads to welfare losses. Therefore, it is relevant to investigate the effect of industrial concentration on price rigidity in the Indonesian food and beverages industry.

Furthermore, high industrial concentration could reduce the efficiency of transformation of inputs into outputs (i.e. technical efficiency). Higher technical efficiency can also result in a competitive price and product quality which can reduce welfare losses. The first line of reasoning states that the few firms in a highly concentrated industry tend to be inefficient because there is no incentive and no pressure from other competitors. The second line of reasoning says that the few leading firms dominating the market may experience economies of scale. Also the dominant firms may invest their abundant resources in a better technology that makes them more efficient. Thus, high industrial concentration and the benefits that it entails for some firms may have a positive relationship with technical efficiency. This suggests that firms may be allowed to grow larger in size, while at the same time, allowing industrial concentration to increase. Therefore, an empirical investigation that clarifies which argument prevails in the Indonesian food and beverages industry is relevant for policy makers.

Last but not least, previous studies pointed out that there is an inter-relationship between industrial concentration, price rigidity, price-cost margin, and technical efficiency in one system of equations (see Zellner, 1989; Kalirajan, 1993; and Caucutt *et al.*, 1999). Also, there may be variables having a two-way causal relationship in the system, because the firms in the industry may respond simultaneously to a change in one variable. For example, if a few firms dominating the industry find that there is a positive effect of industrial concentration on the price-cost margin, then the few firms might use their high price-cost margin (for example, by investing more on the technology) to increase their shares, which in turn, increases industrial concentration simultaneously. Therefore, investigation of all variables in one system of equations is important, since the existence of the inter-relationships among the variables would make the policy makers face a more complicated policy design problem. The presence of a two-way relationship between the variables requires the policy maker to intervene in the market by influencing several factors at the same time. Also the possibility of a bi-directional relationship between industrial concentration and technical efficiency has policy implications, i.e. it determines whether the policy should limit a few firms to grow in scale or whether growth of scale and market share should be discouraged.

Besides the policy importance of investigating industrial concentration, price rigidity, price-cost margin, and technical efficiency, this research is scientifically important because such an analysis has not been done comprehensively in Indonesia. Also the investigation only of the food and beverages industry could give more precise policy implications. Previous investigations about the relationship between industrial concentration, price rigidity, technical efficiency, and price-cost-margin by Bain (1951, 1956), Zellner (1989), Kalirajan (1993) and Caucutt *et al.* (1999) were done separately in different countries and for different sectors. Therefore, examining the relationship between industrial concentration, price rigidity, technical efficiency, and price-cost-margin for the Indonesian food and beverages industry contributes to the literature.

1.2 Study objective and research questions

The main objective of this research is to examine the market structure, price rigidity, and performance as well as their relationships in the specific context of the Indonesian food and beverages industry. The objective of the thesis is met by addressing the following research questions:

1. Does industrial concentration converge across subsectors of the food and beverages industry and what is the relationship between industrial concentration and price-cost margin after the introduction of the competition law in 1999?
2. Does industrial concentration have a causal impact on technical efficiency or is there a two-way causal relationship between these variables?
3. Does high industrial concentration limit price movements, especially when production cost decreases?
4. How are industrial concentration, price rigidity, technical efficiency, and price-cost margin related when examined in a system?

1.3 Market structure, price rigidity, and performance

The link between market structure, price rigidity, and performance has long been a topic of interest to researchers in industrial organization. Based on the same theme, this research focuses on the crucial role of measuring and relating market structure, price rigidity, and performance in Indonesia, comprehensively.

Market structure is a state of market with respect to competition. There are four main types of market structure with respect to the seller competition: perfect market competition, monopolistic competition, oligopoly, and monopoly (Nicholson, 2004). This research uses the degree of seller concentration as a measure of market structure that can classify the industry into one of the aforementioned categories of market structure. Price rigidity is observed when the price fails to adjust to external conditions because of factors such as market power of firms in a highly concentrated industry. Furthermore, performance is a result achieved by a firm as a consequence of its market structure or conduct. This research uses price-cost margin and technical efficiency as measures of performance.

A number of theoretical frameworks underpin the relationship between industrial concentration, price rigidity, technical efficiency, and price-cost margin in this research. The first framework is the Structure-Conduct-Performance (SCP) framework. According to the original SCP framework (Bain, 1956), industrial concentration has one single direction of causality affecting price rigidity and performance. This single direction has been challenged by many theoretical and empirical studies. For example, Clarke and Davies (1982) suggested that price-cost margin could also affect industrial concentration. In reaction to these findings, the new SCP framework (see Schmalensee, 1982; Lipszynski and Wilson, 2001) suggests that there is also a feedback from performance to conduct to structure, since the firms are actively pursuing their strategies in response to changes in the market.

Within the SCP framework, there are two hypotheses regarding the relationship between industrial concentration and technical efficiency, i.e. the efficient-structure and quiet-life hypotheses. The efficient-structure hypothesis provides an explanation for the positive relationship between industrial concentration and efficiency (Berger and Hannan, 1997). The quiet-life hypothesis suggests a negative relationship between industrial concentration and industrial performance (Hicks, 1935). Finally, the absolute convergence model is applied within the SCP model to investigate the convergence of industrial concentration in the industry.

The second framework used in this thesis is new empirical industrial organization (NEIO) framework to derive an estimable model by combining the Cournot oligopoly and partial adjustment models. This model also departs from the SCP framework with regard to explaining the relationship between price rigidity and industrial concentration by using the derived indicator of price adjustment which could not be provided by the SCP framework.

1.4 Description of data

This research uses secondary data from the Indonesian Bureau of Central Statistics (BPS). This research uses annual survey data of medium and big manufacturing firms which are collected by BPS. BPS defines medium-sized firms as those firms employing more than 20 workers. Firm-level (establishment) data classified into five-digit Klasifikasi Baku Lapangan Usaha Indonesia (KBLI) level of the food and beverages industry over the period from 1995 to 2006 are used. KBLI is comparable with the International Standard Industrial Classification (ISIC).

Since the data are already tabulated by the BPS, issues such as data representativeness and quality may arise. Regarding the data representativeness, the survey covers all medium and big manufacturing firms. BPS collects the data from more than 6000 firms in the food and beverages industry per year, on average. The data are collected by the Sub-district statistical officer and Regency/municipality statistics officer. Therefore, the data used in this research represent very well the Indonesian food and beverages industry. The data include information on the number of workers, wages and salaries, materials used, production, cost structure of input, cost structure of output, and energy consumption.

With respect to the data quality, all variables in the data survey are also well-defined and measured with a complete lay-out questionnaire. For example, input data are taken from the data on input use and are measured in Indonesian Rupiah. Although the data are well-defined, the data set suffers from a number of usual problems in data sets like the presence of outliers and the possibility of measurement error. Outlier detection and elimination and econometric methods have been used in this thesis to overcome the problems.

This research also considers a structural change that might affect the data during the period of investigation. The structural change can be caused by a major economic crisis in 1997 and the introduction of the competition law. Also the economic crisis caused a number of firms to disappear from the sample because of bankruptcy. In addition, the introduction of the competition law may have affected the market share of dominant firms and may have affected significantly variables such as input and output of other firms as well as output prices.

1.5 Outline of the thesis

The remainder of this thesis is organized as follows.

Chapter 2 investigates the industrial concentration and price-cost margin in the food and beverages industry. This chapter answers research question 1 about the industrial concentration convergence as well as the relationship between industrial concentration and price-cost margin. The effect of the introduction of the competition law in 1999 on industrial concentration and price-cost margin is also examined in this chapter.

Chapter 3 measures technical efficiency and examines its relationship with industrial concentration in the food and beverages industry. This chapter calculates technical efficiency using DEA and examines its relationship with industrial concentration. Granger-causality as well as panel data analysis are used to examine the relationship between technical efficiency and industrial concentration.

Chapter 4 investigates the relationship between industrial concentration and price rigidity, theoretically and empirically. A model derived from the Cournot oligopoly and partial adjustment models are used to see the effect of industrial concentration on price rigidity. The model is estimated using panel data techniques.

Chapter 5 analyses the relationship between industrial concentration, price rigidity, price-cost margin, and technical efficiency using a system of equations. This research investigates whether there is a simultaneous relationship among the variables in the system. An appropriate panel-system of equations model is used to estimate the relationships.

In *chapter 6,* the findings from the four last chapters are synthesized to provide conclusions and policy implications. Also recommendations for further research are derived from this thesis.

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Chapter 2

Industrial Concentration and Price-Cost margin of the Indonesian Food and Beverages Industry

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Abstract

This paper investigates trends in industrial concentration and its relationship with the price-cost margin in 54 subsectors of the Indonesian food and beverages sector in the period 1995-2006**.** This study uses firm-level survey data provided by the Indonesian Bureau of Central Statistics (BPS), classified at the five-digit International Standard Industrial Classification (ISIC) Level. The results show a significant increase in industrial concentration in 1995 to 1999, which coincided with the period of the economic crisis in Indonesia. After 1999, the industrial concentration exhibits a slightly decreasing long-term trend. Furthermore, the industrial concentration for all subsectors tends to converge to the same value in the long run. Additionally, results show that higher industrial concentration yields a higher price-cost margin. Finally, the introduction of the competition law in 1999 has slightly lowered industrial concentration and the price-cost margin.

Keywords: industrial concentration, price-cost margin, competition law, food and beverages sector

2.1 Introduction

It is well known that the industrial concentration in almost all of the economic sectors of Indonesia is relatively high (see Bird, 1999). Some sectors in the industry may have a stable and high industrial concentration because of the barriers to entry for new potential firms. The barriers may be caused by natural conditions, such as economies of scale moulded by incumbents, or formal regulations, such as exclusive monopolies, or business strategy.

One of the industry sectors with a high concentration is the food and beverages sector. Data presented by Bird (1999) showed that almost all of the subsectors of the food and beverages sector are highly concentrated. Furthermore, Bird concluded that for some of them, high concentration is particularly persistent.

The food and beverages sector contributes significantly to the Indonesian gross domestic product (GDP). Since 2004, the output of this sector accounted for about 7% of the GDP and about 23% of the total industrial manufacturing output. This sector plays a vital role in the Indonesian economy and is a public concern, especially in fulfilling basic food needs. Furthermore, the total Indonesian population of about 206 million in 2000 indicates that this industry is an important sector. Additionally, the food and beverages sector absorbed about 23% of total employment in the Indonesian manufacturing industry in 2006, and employment in the industry grew significantly (about 19%) in 2006 compared to 2005.

Naturally, policy makers and researchers pay considerable attention to the relationship between the degree of competition and the price markup in the food and beverages sector, mainly because high industrial concentration in the sector will lead to the extraction of consumer surplus by the firms, with consequences for the entire population, but especially for lower income households. The higher industrial concentration may induce a few dominant firms with market power to behave collusively and to generate excess profits by keeping food prices higher than in a more competitive market.

In 1999, the Indonesian Competition Law No. 5 1999 was established. This law was designed to increase effectiveness and efficiency in economic activities through the creation of fair business competition and, subsequently, to improve the people’s welfare. The Commission for the Supervision of Business Competition (KPPU) has been the body responsible for enforcing the law in Indonesia. Although the KPPU has limited the anti-competitive behavior of firms, the high concentration in the food and beverages sector continues to exist. Furthermore, a study investigating the competition law in Indonesia that was conducted after the competition law had been established (Pangestu *et al.*, 2002) found ambiguities that are still subject to interpretation in the competition law. The ambiguities may make the investigation and the law enforcement on anti-competitive behavior ineffective.

Some previous studies, such as Hill (1987) and Bird (1999), focused on the industrial concentration before the Indonesian Competition Law was implemented. Hill (1987) and Bird (1999) observed the industrial manufacturing concentration in Indonesia and found that the seller concentration was remarkably high. Similar research about the trend of the industrial concentration in another Asian country, Malaysia, was conducted by Bhattacharya (2002). However, a thorough study of the trend of industrial concentration in the food and beverages sector has never been conducted in Indonesia.

As briefly explained in the Structure-Conduct-Performance (SCP) paradigm, the firms in the concentrated industry will have a better industrial performance (usually measured by profitability or price-cost margin). Some research related to the relationship between the industrial concentration and the price-cost margin has been conducted, but mostly in the U.S. and some European countries (Collins and Preston, 1969; Khalilzadeh-Shirazi, 1974; Ghosal, 1989; and Prince and Thurik, 1992; Dickson, 2005). A few studies have focused on the relationship between industrial concentration and price markup in Asian countries. Gan (1978) and Kalirajan (1993), for example, observed that there was a positive and significant influence of industrial concentration on the price-cost margin in Malaysian manufacturing. Go *et al.* (1999) also found a positive relationship between the seller's concentration and the price-cost margin in Filipino manufacturing industries. Most of the research conducted to date investigated all subsectors of the manufacturing industry. Additionally, the research connecting the relationship between industrial concentration and the price-cost margin in the Indonesian food and beverages sector is hardly found in the published literature, nationally or internationally. The information about the relationship between the industrial concentration and the price-cost margin will provide further insight for the policy makers on whether the firms in the industry gain more producer surplus through the lessening of the competition and anti-competitive behavior in the industry. Therefore, the investigation of the effect of industrial concentration on industrial performance has a high relevance for policy makers.

The objectives of this paper are twofold. First, this paper analyzes the trend of industrial concentration in the Indonesian food and beverages sector in the period before and after the establishment of Indonesian Competition Law. The analysis of the trend includes a test for the convergence of industrial concentration in the long run. Second, this paper analyzes the relationship between industrial concentration and the price-cost margin in the Indonesian food and beverages industry. Additionally, the effect of the competition law establishment on the price-cost margin is measured.

2.2 Industrial concentration and the price-cost margin

Industrial concentration is a common measure of market structure[1]. It reflects both the number and size distribution of firms in an industry. The industrial concentration may represent the market power and the probability of anti-competitive behavior among firms in the market.

The most commonly used measures of industrial concentration are the concentration ratio for *n* firms (*CRn*) and the Herfindahl-Hirshman Index (*HHI*), which is based on Pepall *et al.* (2008). Both indicators of industrial concentration are based on the market share of the firms and calculated by the following formulas:[2]

$$CR4_j = \sum_{i=1}^{4} MS_i \tag{1}$$

$$HHI_j = \sum_{i=1}^{n} (MS_i)^2 \tag{2}$$

[1] We define industrial concentration as in Bain (1951)

[2] Considering stocks, this paper calculates industrial concentration based on sales data because sales seem to explain more about the market share than the output.

where $j = 1,2,\ldots, m$ indexes the subsector, $i = 1,2,\ldots n$ indexes firm i in a subsector, and MS_i is the market share of firm i in its respective subsector. *CR4* considers the collective share of the four largest firms in a subsector, while HHI_j considers the inequality of distribution of market shares among all firms in subsector j.

Both the *CR4* and the Herfindahl-Hirschman Index (*HHI*) measures have a limitation in the calculation, but they complement each other.[3] Hence, it is necessary to use both concentration measures to clearly picture the market structure in the industry.

Additionally, there are some shortcomings related to the calculation of the concentration ratio (*CR4* and *HHI*). The calculation of the concentration ratio will underestimate or overestimate the "true concentration" for a series of reasons (Bird, 1999). First, the survey of industrial manufacturing in Indonesia includes only the firms classified into large and medium firms.[4] This may overestimate the industrial concentration because small firms are not reported in the survey. Second, BPS reports firm data based on establishment. The industrial concentration may be underestimated because the calculation may include leading firms that have more than one establishment. Third, the unavailability of information on merger activity in the data, especially about horizontal mergers, is likely to lead to an underestimation of the industrial concentration. Fourth, because the industrial concentration may be higher in the regional than in the national level, the calculation of industrial concentration in the national level will be underestimated. Finally, it is noted that the industries examined may not be "markets" (see Kamerschen, 1994 for details).

[3] *CR4* is commonly used to classify the market into some categories of oligopoly (see Shepherd, 1999), but it cannot capture the distribution of the market share for all firms in the market. However, *HHI* can capture the distribution of the a firm's market share in a market, but it is rather difficult to classify the oligopoly categories from the *HHI*. In spite of this, Besanko *et al.* (2004) gave a classification of market structure based on *HHI*. Furthermore, Liebenberg and Kamerschen (2008) also discussed the importance of using both *HHI* and concentration ratio.

[4] BPS defines medium-sized firms as those firms employing more than 20 workers.

The degree of the biases induced for the reasons mentioned above may not be substantial. Bird (1999) gives some arguments in this regard. First, Hill (1990) argued that, in the aggregate, the exclusion of small firms is not a serious problem because small firms contribute no more than 15% of the total manufacturing value added in 1985. Second, different results may exist in the industrial concentration calculation between the method that uses the calculation from BPS establishment data and the one that uses the primary firm data. Although there will be differences, the industrial concentration trend may still be captured quite accurately. Third, vertical, rather than horizontal mergers, are more frequent in Indonesian economy. Therefore, the unavailability of information on merger activity will not have a great impact on the industrial concentration calculation. Finally, all factors underestimating or overestimating the concentration appear not to undermine the trend of the concentration, if their net effects remain constant over time (Bird, 1999).

This paper also estimates the effect of industrial concentration on industrial performance measured by the price-cost margin. The relationship arises because higher industrial concentration may lead to higher industrial performance (Bain, 1951; Gupta, 1983). A mathematical derivation of the effect of industrial concentration on the price-cost margin can be found in Saving (1970), Cowling and Waterson (1976), Fischer and Kamerschen (2003a, b), and Kamerschen *et al.* (2005).

Industrial performance is measured by price-cost margins (Khalilzadeh-Shirazi, 1974; Domowitz *et al.*, 1986; Prince and Thurik, 1992). The price-cost margin (*PCM*) is calculated according to the formula proposed by Domowitz *et al.*[5] (1986) and Prince and Thurik (1992). This formula allows for changes in inventories (ΔInventories), considering that changes in

[5] Their (1988) article which has a connection to this article has been challenged by Kamerschen and Park (1993a, b). In the same year, Domowitz *et al.* (1993) replied that they did not view the Comment by Kamerschen and Park (1993a, b) as a substantive criticism of their (1988) paper, and the issue remains open.

inventories are important with regard to the fluctuation in the business cycle in the Indonesian economy from 1995-2006:

$$PCM = \frac{Value\ Added - Cost\ of\ Labor + \Delta Inventories}{Sales + \Delta Inventories} \qquad (3)$$

Value added is calculated by sales minus intermediate inputs except labor cost.

2.3 Data

The *CR4* and *HHI* for the food and beverages industry are calculated using firm-level data from the Annual Manufacturing Survey provided by the Indonesian Bureau of Central Statistics (BPS). The dataset covers the period from 1995 to 2006. This paper uses that period because of the tractable and comparable data for all subsectors among the years. Furthermore, data beyond 2007 have not yet been published.

There are 59 subsectors of International Standard Industrial Classification (ISIC) Level[6] in the food and beverages industry, 55 of which are related to food processing, with the remaining to the beverages industry. This paper excludes five subsectors from the analysis because they contain less than four firms in each period. Therefore, this paper uses only 54 of the subsectors in the industry. During the period covered by the data, there were, on average, 5488 firms in the market. About 7.6 percent of them, on average, were involved in exporting activities. In 1995 the food and beverages sector had 5335 firms. This number increased significantly to 7897 in 2006. Despite this, the number of firms had decreased significantly from 5495 to 4850 (a drop of 12%) in 1998, the year that coincided with a major economic crisis in Indonesia.

[6] Actual codes used are not the ISIC codes, but comparable, coming from Klasifikasi Baku Lapangan Usaha Indonesia (KBLI)

Table 2.1 Descriptive statistics of the variables from 1995-2006

Variable	Mean	Standard Deviation	Coefficient of Variation	Minimum	Maximum
CR4	0.633	0.274	0.433	0.081	1.000
HHI	2266	2143	0.946	51.500	10000
PCM	0.181	0.126	0.696	-0.380	0.708
Size (Log of VA)	13.700	2.227	0.162	5.552	18.498
Growth	0.453	1.319	2.912	-0.942	6.963
COR	0.018	0.161	8.944	$5.27 \cdot 10^{-6}$	3.937
N-Subsectors	54	54	54	54	54

Source: Authors' calculation

Table 2.1 shows that the data are relatively heterogeneous, with relatively high standard deviations and coefficients of variation for all variables. In the period covered by the data, it is observed that the average of *CR4* is 0.6328, which characterizes the food and beverages sector as a tight oligopoly, according to the criteria of Shepherd (1999). It is also seen that the average *HHI* is 2266, which according to Besanko *et al.* (2004), this classifies the food and beverages sector as an oligopoly. The average *PCM* of 0.181 also indicates that the firms in the sector have a positive price markup. Regarding all variables, the data on demand growth (*Growth*) and capital-output ratio (*COR*) are very heterogeneous.[7] The heterogeneous condition of the demand growth and capital-output ratio are related to the economic condition and capital-output applied by the firms, respectively.[8]

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[7] Although the data on demand growth and capital-output ratio are too heterogeneous, this may not undermine the accuracy of the estimation given that these two variables appear only as instruments in the model.

[8] The lowest demand growth is found on subsector 15316 (Nuts), which dropped about -94.21% in 2002 compared to 2001. According to the data survey, this may be caused by firms exiting the market, as well as the decrease in the demand for this product in 2002. The highest demand growth was experienced by subsector 15134 (Dried Fruit and Vegetables), which increased about 696% in 1998 compared to 1997. The significant increase of the demand growth in 1998 is caused by the considerable increase of sales in 1998, after the sales drop caused by the crisis, starting in mid-1997. The high variation of the capital-output ratio seems obvious because of the different capital used in each subsector. The subsector with the highest capital-output ratio is

2.4 Empirical model and estimation

This paper uses two econometric models to investigate the trend of industrial concentration and the relationship between industrial concentration and the price-cost margin. The first model examines the trend of industrial concentration in the industry. It measures whether there is a trend for the industrial concentration to move to a certain value. To confirm the movement of the trend of industrial concentration for all subsectors in the food and beverages sector, this paper uses the theory of absolute convergence[9] (Barro and Sala-i-Martin, 1992; Sala-i-Martin, 1996; Sorensen and Whitta-Jacobsen, 2005). The model can indicate whether there is a tendency for the convergence of the industrial concentration in the long run to one and the same point for all subsectors. In other words, the model assumes that all subsectors have the same steady state in the long run. The assumption is relevant because all subsectors face the same business characteristics in the Indonesian economy. The absolute convergence model[10] is defined as:

$$\frac{Ln\ MS_{t_n}^{j} - Ln\ MS_{t_0}^{j}}{T} \cong \beta_0 - \beta_1\ Ln\ MS_{t_0}^{j} \qquad (4)$$

where $j = 1,2,\ldots,54$ indexes subsector, t_0 is the initial year for which data are available (1995), and t_n is the final year (2006). MS_t^j is the market structure in period t and subsector j, captured by the *CR4* and *HHI*. The model is estimated using cross section regression. The food and beverages sector exhibits convergence in market structure if the estimated coefficient of β_1 is significantly positive.

The second model estimates the effect of industrial concentration on the price-cost margin in the industry. Higher industrial concentration, followed by higher market power,

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15143 (coconut oil), with a value of 3.937, whereas the subsector with the lowest capital-output ratio is 15510 (liquors), with capital-output ratio of $5.27 \cdot 10^{-6}$.

9 This model is different from the model used by Bird (1999), who also investigated the trend of the industrial concentration using the models of Khemani (1980) and Brozen (1982).

10 Derivation of this model can be found in Barro and Sala-i-Martin (1992) and Sala-i-Martin (1996).

increases the ability of the firms or an industry to influence the market equilibrium price. Thus, higher concentration is expected to lead to higher price-cost margins. Moreover, based on Konings *et al.* (2001), McCloughan *et al.* (2007), and Looi Kee and Hoekman (2003), the effect of the competition law on the price-cost margin is also investigated. The competition law is represented by the dummy variable of the competition law establishment in Indonesia as used by Looi Kee and Hoekman (2003). This paper also interacts the competition law dummy variable with the industrial concentration. This interaction variable can capture in the way industrial concentration affects the price-cost margin after the competition law establishment. The effect of the industrial concentration on the price-cost margin may be lower after the establishment of the competition law because the law can break the cartel and other anti-competitive behavior. As a result, the competition law is also hypothesized to affect the price-cost margin indirectly through its influence on the industrial concentration. In addition, this paper also introduces trend variables and their interaction with the competition law dummy variable to see the trend of the price-cost margin in the whole period as well as the competition law effect on the trend of the price-cost margin. The final model of the industrial performance-concentration model[11] is:

$$PCM_{jt} = \gamma_j + \theta_1 MS_{jt} + \theta_2 Law_t + \theta_3 Law_t \cdot MS_{jt} + \theta_4 Trend_t + \theta_5 Trend_t \cdot Law_t + v_{jt} \qquad (5)$$

where j and t index subsector and time, respectively. *Law* is a dummy variable that assumes the value 1 for the years after the establishment of the competition law (1999), $Trend = 0,1,2,\ldots,T$, v is the error term, and *PCM* is the price-cost margin.

Regarding the relationship between industrial concentration and the price-cost margin, there is an endogeneity problem in the variable of industrial concentration (Clarke and Davis, 1982; Kalirajan, 1993). This endogeneity may arise because of the argument that the derivation of the price-cost margin comes from an equilibrium condition for profit

[11] The derivation of the relationship between industrial concentration and price-cost margin can be found in Cowling and Waterson (1976) and Clarke and Davis (1982).

maximization (Jacquemin *et al.*, 1980; Kalirajan, 1993). Additionally, Clarke and Davies (1982) established the endogeneity problem through underlying cost and demand conditions. Therefore, this paper uses some instrumental variables for the industrial concentration. The instrumental variables chosen are based on the works of Mueller and Hamm (1974), Khalilzadeh-Shirazi (1974), Gupta (1983), Prince and Thurik (1992), Kalirajan (1993), Go *et al.* (1999), and Delorme *et al.* (2002). The main instrumental variables estimating the industrial concentration are industry size (*Size*), growth of demand (*Growth*), and capital-output ratio (*COR*). Besides the three main instrumental variables, this paper also uses a competition law dummy variable and trend variables as exogenous in the equation that determines *PCM*.

Equation (5) is estimated using unbalanced panel data techniques.[12] This method uses either a fixed effects or random effects model based on the Hausman (1978) test. The fixed-effects model is chosen if the Hausman test shows that there is correlation between individual effects and other regressors. Otherwise, the random effects model will be used. In addition, the fixed-effects model uses dummy variables of the subsectors as the source of the heterogeneity, whereas the random effects model uses the intercept deviation of each subsector across the intercept for all subsectors.

2.5 Results

2.5.1 Trends of average industrial concentration

Table 2.2 describes the industrial characteristics such as concentration for the *CR4* (4 firms), the Herfindahl-Hirschman Index (*HHI*), the distribution of the number of firms, and the average price-cost margin. The table shows that the industrial concentration was high from 1995 to 2006, but there was a slightly declining trend, especially after the year 2000. This

[12] Some subsectors, such as 15145 and 15149, are not reported in 2006.

finding suggests that industrial concentration increased steadily before the establishment of Indonesian Competition Law No. 5 1999. After the establishment of the law, the industrial concentration decreased slightly over time. Furthermore, the *CR4* and *HHI* decreased on average by 0.7% and 0.8%, respectively, every year from 1995-2006. The average increasing number of the firms in the industry every year may also be the reason for which the concentration is decreasing.

The price-cost margin is always positive and exhibits a significant increase by on average 100.47% from 1995-1999, which coincided with hyperinflation in 1997-1998 (firms sold the old stock at a new price) and the increase in the industrial concentration. The increase in the average industrial concentration from 1995-1999 may also have been caused by firms exiting the industry, especially from 1997-1999 because of the economic crisis. From 1998-1999 there was a 12% reduction in the number of firms in the industry. The reduction in the growth of the price-cost margin occurred simultaneously with the decline of the growth of the concentration from 2000-2006.

Table 2.2 Industrial characteristics 1995-2006

Year	*CR4*	*HHI*	Number of Firms	Average *PCM*
1995-1997	0.645	2572	5495	0.069
1998-2000	0.713	3142	4850	0.225
2001-2003	0.650	2381	5299	0.197
2004-2006	0.626	2345	6308	0.235
Average % Change 1995-2006	-0.693	-0.796	5.133	38.593
Average % Change 1995-1999	3.442	8.019	-5.982	100.470
Average % Change 2000-2006	-3.056	-5.833	11.485	3.234

Source: Authors' calculation

Based on the estimation of Eq. 4, Table 2.3 shows that the parameter estimate for the initial industrial concentration is negative (implying that $\beta_1>0$), which means that there is absolute convergence in the industrial concentration in the long run. Therefore, in the long run, industrial concentration tends to converge to one and the same value for all subsectors. It can be concluded that the subsectors with a relatively low industrial concentration in 1995 grew relatively fast after the year 1995.

Table 2.3 Absolute convergence of industrial concentration

Independent Variable	Dependent Variable: $\frac{\text{Ln CR4}^j_{2006} - \text{Ln CR4}^j_{1995}}{T}$	Dependent Variable: $\frac{\text{Ln HHI}^j_{2006} - \text{Ln HHI}^j_{1995}}{T}$
	Coefficients	Coefficients
Intercept	-0.025***	0.270***
	(0.008)	(0.073)
$\text{LnCR4}_{j,1995}$ $(-\beta_1)$	-0.029***	
	(0.007)	
$\text{LnHHI}_{j,1995}$ $(-\beta_1)$		-0.039***
		(0.010)
R^2	0.231	0.222
F-statistics	15.606***	14.806***

Notes: Values of SE are given within parentheses

*** denotes test statistic significance at the 1% level

Source: Authors' calculation

Table 2.4 also supports this finding. It shows that the five most concentrated industries (according to *CR4*) tend to change slowly over times and some of them experienced concentration reduction, such as the milk, food and wheat flour subsectors. The five least concentrated (*CR4*) subsectors experienced a significant increase in concentration. For three of them, the increase was larger than 15%, on average.

Table 2.4 Average % change of industrial concentration (*CR4*)

The Five Largest *CR4*	**Average % Change**	**The Five Lowest *CR4***	**Average % Change**
15212 (Milk Food)	-1.015	15492 (Ice Cubes, other ices)	6.73
15530 (Beer)	0.055	15311 (Rice Milling)	19.41
15321 (Wheat Flour)	-1.827	15141 (Crude Cooking Oil)	17.64
15131 (Canned Fruit, Vegetables)	1.043	15496 (Crackers and Other Chips)	17.08
15329 (Other Starch Nec)	1.401	15323 (Tapioca)	1.17

Source: Authors' calculation

2.5.2 The effect of industrial concentration on price-cost margin

Table 2.5 shows the results of the estimation of Equation (5), which is estimated using a fixed-effects model with stationary level-form data. The fixed-effects model is used because the Hausman (1978) test rejected the random effects specification. Furthermore, based on the stationarity test of Levin, Lin, Chu (LLC) test (2002), the null hypothesis of non-stationary data of the *CR4* and *PCM* is rejected at the 1% critical level, which indicates that the data at the level form are valid for use in the model.

The White test for heteroscedasticity (Castilla, 2008) rejects the null hypothesis of the absence of heteroscedasticity at the 1% critical level. To address the problem of heteroscedasticity, this paper applies the generalized least square (GLS) method to estimate the model.

The results in Table 2.5 suggest that industrial concentration has a significant effect on the price-cost margin, both for the *CR4* and *HHI* measures. As expected, higher industrial concentration yields a higher price-cost margin for the firms. The *CR4* coefficient of 0.824 indicates that the price-cost margin will increase by 0.824% following a 1% rise in industrial concentration. Additionally, the *HHI* coefficient of 0.091 shows that the price-cost margin will increase by 0.091 units for every 1-unit (1000) increase in *HHI*. Therefore, results show that firms in the food and beverages sector benefit from the oligopolistic market structure. This result is also supported by the data, given that every year, on average, the industry experienced about 18.1% of price-cost margin from 1995-2006 (see Table 2.1). The results presented here also support the findings of other studies, such as Khalilzadeh-Shirazi (1974), Prince and Thurik (1992), Kalirajan (1993), Go *et al.* (1999), and Delorme *et al.* (2002), which found a positive impact of industrial concentration on the price-cost margin.

Table 2.5 Regression of industrial concentration and other variables on the price-cost margin

Independent Variable	**Dependent Variable : AVERAGE *PCM***	
	Coefficients	**Coefficients**
Intercept	-0.499***	-0.189***
	(0.110)	(0.043)
CR4	0.824***	
	(0.196)	
HHI		0.091***
		(0.025)
Law	0.373***	0.339***
	(0.043)	(0.033)
Law*CR4	-0.342***	
	(0.088)	
Law*HHI		-0.064
		(0.019)
Trend	0.036***	0.049***
	(0.012)	(0.011)
Trend*Law	-0.031**	-0.049***
	(0.013)	(0.011)
R^2	0.273	0.338
F-statistics	9.690***	10.651***

Notes: ** denotes test statistic significance at the 5% level   Values of SE are given within parentheses

*** denotes test statistic significance at the 1% level

Source: Authors' calculation

Furthermore, based on the estimated fixed effects of both models with *CR4* and *HHI*, it is observed that without any influences of the industrial concentration and other variables in the model (ceteris paribus), the subsectors of the food and beverages sector have a heterogeneous price-cost margin.[13] It is also found that the subsectors that are among the least concentrated have a high price-cost margin, indicating that for these subsectors, the degree of concentration is not a very good predictor of *PCM*. Instead, the high price-cost margin is captured in the model by the fixed-effects,[14] which is not surprising because fixed effects parameters take into account some unobserved heterogeneities, such as different characteristics of the industry and scale effect.

The parameter associated with the trend suggests a positive movement of the price-cost margin during the period. The trend variable coefficient shows that the price-cost margin increases by 0.036 and 0.049 each year for the *CR4* and *HHI* models, respectively.

To examine the effect of the competition law on the price-cost margin, the first order derivatives are calculated for the *CR4* and *HHI* models. We obtain:[15]

[13] In the *CR4* model, the lowest and the highest fixed effects parameters are -0.248 and 0.333, respectively. Almost similar to the *CR4* model, in the *HHI* model, the lowest and the highest fixed effects parameters are -0.253 and 0.200, respectively.

[14] Based on the parameters of the fixed effects of the model with *CR4*, some subsectors, such as 15492 (ice cubes and other ice products), 15421 (granulated sugar), 15141 (crude cooking oil), 15540 (soft drinks), and 15496 (crackers and other chips), have the highest price-cost margin in the period of estimation. However, some subsectors, such as 15329 (other starch nec), 15321 (wheat flour), 15530 (beer), 15134 (dried food, vegetables), and 15312 (other grain milling), have the lowest price-cost margin in the period of estimation. Also, based on the parameters of the fixed effects of the model with *HHI*, some subsectors, such as 15421 (granulated sugar), 15510 (liquors), 15540 (soft drinks), 15139 (other fruit and vegetables), and 15141 (crude cooking oil), have the highest price-cost margin in the period of estimation. However, some subsectors, such as 15329 (other starch nec), 15134 (dried food, vegetables), 15125 (processed fish), 15321 (wheat flour), and 15423 (other sugars), have the lowest price-cost margin in the period of estimation.

[15] We slightly abuse notation here. Although we use the partial derivative sign, we evaluate the effect of the competition law as the dummy variable changes from zero to one.

$$\frac{\partial PCM}{\partial Law} = 0.373 - 0.342 \times CR4 - 0.031 \times trend \qquad (6)$$

$$\frac{\partial PCM}{\partial Law} = 0.339 - 0.064 \times HHI - 0.049 \times trend \qquad (7)$$

The averages for *CR4* and *HHI* are 0.633 and 2266, respectively, and the average trend is 5.5. The net effects of the law on *PCM* are calculated as -0.014 and -0.075 for the *CR4* and *HHI* models, respectively. The results regarding the *Law* variable suggest that the Competition law has affected price-cost margin in various ways. First, the parameters associated with the interaction term of *Law* and the concentration ratios (*CR4* and *HHI*) show that the policy has had a more negative effect on the price-cost margins of subsectors that were characterized by higher concentration ratios, which implies that the policy has been targeted more toward sectors with a high price-cost margin. Second, the parameters of the interaction terms of *Law* and *Trend* (-0.031 and -0.049) (almost) offset the positive single trend term, which suggests that the policy was successful in stopping the upward trend in price-cost margins before 1999.

Regarding the results on the relationship between the law establishment and the price-cost margin, a number of comments are in order. First, the competition policy may not have been applied effectively to reduce market power. McCloughan *et al.* (2007) argues that only an effective competition policy would decrease the price-cost margin. Additionally, Pangestu *et al.* (2002) found ambiguities that are still subject to interpretation in the Indonesian competition law, which may make the investigation and the law enforcement on anti-competitive behavior ineffective. Second, the political stability and improved economic environment in 2004-2006 may have resulted in higher profits, thereby confounding the effects of the competition law. Better stability and economic environment during 2004-2006 may come as a result of successful parliamentary and presidential elections in 2004. Indeed, the data in Table 2.2 show that the price-cost margin increased steadily from 2004 until 2006.

Third, the law establishment may induce firms to innovate and produce differentiated products that may sustain higher prices (Looi Kee and Hoekman, 2003), which may result in higher price-cost margins. Indeed, since 1999, the variety of products has been significantly increasing in Indonesia. Fourth, the increase of the industrial concentration for subsectors with low industrial concentration in the initial year may cause the increase of the price-cost margin, on average (as predicted by the model of absolute convergence in Equation (4)). This finding is in line with the finding that the competition law affected the subsectors with high industrial concentration ratios more seriously. Finally, although there are some factors that may cause the elevation of the price-cost margin, this result may give a further recommendation for an improvement in the competition law in the industry.

2.6 Conclusions

This paper has investigated the trend and convergence of industrial concentration in the Indonesian food and beverages sector. Moreover, it has analyzed the relationship between the industrial concentration and the price-cost margin. This paper contributes to the literature by applying the concept of convergence to the analysis of the trend in industrial concentration. Furthermore, this paper contributes an analysis of the relationship between market structure and industrial performance in the food and beverages sector in Indonesia.

The results show that the industrial concentration of the subsectors in the food and beverages sector tend to be slightly lower in the long run, but the subsectors of the industry still have a high industrial concentration (tight oligopoly structure) in the period covered by the data. In addition, results show that the industrial concentration converges to the same value for all subsectors. Finally, as expected, the industrial concentration is found to have a positive effect on the price-cost margin.

The competition law has been relatively more successful in reducing the price-cost margin in subsectors that are characterized by a relatively high industrial concentration. Furthermore, the law has almost stopped the upward trend in price-cost margins that existed before the implementation of the law. Nevertheless, the price-cost margin is still higher after the competition law establishment than before, which suggests that a further improvement of the competition law is warranted.

The results of this paper demonstrate that higher concentration in a subsector leads to a higher price-cost margin. One way to lower anti-competitive behavior is to eliminate barriers to entry, which effectively lowers concentration. However, the results presented here suggest that the effect of the competition law on the price-cost margin is through the concentration. More precisely, the competition law lowers the effect of concentration on the price-cost margin by breaking cartels.

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Chapter 3

The Relationship between Technical Efficiency and Industrial Concentration: Evidence from the Indonesian Food and Beverages Industry

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Abstract

This paper investigates the relationship between technical efficiency and industrial concentration in the Indonesian food and beverages sector. Firm-level data obtained from the Indonesian Bureau of Central Statistics (BPS) are used to estimate technical efficiency scores and calculate measures of industrial concentration. The results show that the food and beverages industry is characterized by high industrial concentration and firms in the industry are inefficient. The Granger-causality test suggests a one-way direction of causality, with industrial concentration having a negative impact on technical efficiency, at the sector level. This suggests that the quiet-life hypothesis, rather than the efficient-structure hypothesis, applies to the Indonesian food and beverages industry.

Keywords: technical efficiency, industrial concentration, quiet-life hypothesis, efficient-structure hypothesis, data envelopment analysis (DEA)

3.1 Introduction

The food and beverages sector is one of the economic sectors that contributes significantly to the Indonesian gross domestic product (GDP) and employment absorption. Since 2004, the output of this sector accounted for about 7% of the Indonesian GDP and about 23% of the total industrial manufacturing output. Additionally, the food and beverages sector absorbed about 23% of total employment in the Indonesian manufacturing industry in 2006. However, as shown by Setiawan *et al.* (2012), this sector is characterized by a tight oligopoly structure, with the concentration ratio for four firms (*CR4*) being about 66%, and has experienced high price-cost margins in the period 1995-2006. Given the importance of the food and beverages industry in the Indonesian economy, efficient transformation of inputs into outputs is necessary to ensure a competitive price and product quality for the consumers.

Efficiency losses in the food and beverages industry, either caused by firm-level technical or allocative inefficiency or due to oligopolistic power, may have far-reaching consequences for the entire Indonesian economy and the well-being of the local population. This industry fulfills primarily the needs of the local population with imports accounting for about 6% of total consumption in the sector and exports being less than 3% of the value of output in the period 2005-2006. Furthermore, Indonesian households spent about 52.19% of their income on food and beverages products in the period 2005-2006. Any type of inefficiency associated with the sector will be translated to higher consumer prices, which will increase the cost of living and may lead to social unrest. Additionally, there may be interrelationship between the high industrial concentration in the sector and firm-level efficiency.

There are two competing theories that explain the relationship between industrial concentration and efficiency, i.e. the quiet-life (QL) hypothesis and the efficient-structure hypothesis. The quiet-life hypothesis (Hicks, 1935) suggests that high industrial concentration lowers competition among firms, which in turn, reduces incentives for the firms to maximize their efficiency. Gumbau-Albert and Maudos (2002) found that there is a negative relationship between industrial concentration and efficiency, thus supporting the QL hypothesis. Their study showed that firms operating in more concentrated markets had the lowest technical efficiency scores. Also Al-Muharrami and Matthews (2009) observed that more market power means less control on the costs, which makes firms less efficient. Furthermore, Setiawan *et al.* (2012) found that anticompetitive practices exist in the food and beverages manufacturing sectors that are characterized by high industrial concentration. Thus, according to the QL hypothesis, one may deduce that high industrial concentration may lead to inefficiency. The quiet-life hypothesis has been challenged on theoretical grounds

(Stigler, 1976) for not providing a viable alternative to profit maximization as the objective of monopolists and oligopolists.

The second theory, the efficient-structure (ES) hypothesis, states that firms with higher efficiency produce at lower cost per unit of output, which in turn leads to higher profits and larger market share (Demsetz, 1973). This also causes the efficient firms to grow more rapidly in size than less efficient firms. Therefore, profitability and market structure can be a mirror of an efficiency difference among firms. In other words, this hypothesis says that higher industrial concentration may be created by the efficient firms. In line with this hypothesis, Allen *et al.* (2005) found that the efficient-structure hypothesis applied to the trucking industry in the United States.

It is important to find out which hypothesis is relevant for the Indonesian food and beverages sector. Although previous research investigated technical efficiency in this sector, the research did not clarify the relationship between technical efficiency and industrial concentration. For example, Margono and Sharma (2006) estimated only technical efficiency scores in food, textile, chemical, and metal product industries from 1993 to 2000 in Indonesia. Also Ikhsan (2007) only examined technical efficiency in Indonesian's manufacturing industries, including the food and beverages sector, over the period 1988-2000. He found that average technical efficiency for the sector was declining in the period from 1988 until 2000.

Determining which hypothesis applies to the Indonesian food and beverages industry is also important for inferring the correct policy implications in the industry. The two competing hypotheses provide different suggestions to policy makers on actions to take for increasing overall economic efficiency. For example, if the QL hypothesis applies to the industry, resources are wasted by maintaining an oligopoly structure. On the other hand, if the ES hypothesis applies to the industry, physical resources may be economized by having the most efficient firms producing most of the sector's output, but at the same time, allowing for the industrial concentration to increase. Furthermore, evaluating which hypothesis applies to the industry will also have implications with respect to the Indonesian competition law. The Indonesian competition currently places more weight on the QL hypothesis as it fosters competition, as well as, provides law enforcement to break cartels or other anticompetitive practices in the Indonesian economy[1]. Therefore, the study of the relationship between technical efficiency and industrial concentration in the Indonesian food and beverages sector is relevant for designing economic policy measures in Indonesia.

This research focuses on the Indonesian food and beverages industry given its importance for the Indonesian economy. Since industrial concentration in the Indonesian food and beverages industry is known to be relatively high, evidence on whether the quiet-life or efficient-structure hypothesis applies to the industry again would give an indication on whether firms in the industry gain high price-cost margins through formation of cartels or other anticompetitive practices, rather than from efficiency gains. This paper has two aims: first, this paper estimates firm-level technical efficiency and industrial concentration for the Indonesian food and beverages industry[2]. Second, the investigation on the relationship between technical efficiency and industrial concentration is conducted to clarify whether the quiet-life or the efficient-structure hypothesis applies to this industry. Therefore, the final results of this research are relevant from a policy perspective. Furthermore, this research also

[1] Setiawan *et al.* (2012) found that the introduction of the competition law in 1999 had slightly lowered industrial concentration and the price-cost margin in the Indonesian food and beverages industry.

[2] We estimate technical efficiency for each subsector using the firm-level data by averaging the score of efficiency of all firms in the subsector. We calculate average technical efficiency for each subsector because we cannot relate technical efficiency and industrial concentration in the firm-level data. Moreover, it is not possible to use a cost efficiency measure due to unavailability of input price data.

fills in the gap of the literature investigating both hypotheses in the Indonesian food and beverages sector.

Although this research only examines the food and beverages industry, the methods presented here can be equally well applied to other sectors of the economy[3]. Furthermore, given the specific characteristics of each sector, different suggestions and policy implications could be obtained from the application of the techniques to different sectors. Therefore, the test on the applicability of the QL or ES hypothesis in a sector-by-sector basis is more appropriate when detailed results are required for designing economic policies.

The paper is organized as follows. Section II describes the modeling approach which is broken in two steps. In the first step, technical efficiency scores are estimated using data envelopment analysis and industrial concentration is calculated using the four firm concentration ratio and the Herfindahl-Hirschman index. Next, the causality in the relationship between technical efficiency and industrial concentration is tested using the Granger-causality test. This is followed by the description of data in section III and the presentation of the empirical model and results in Section IV. The last section summarizes the results and draws conclusions.

3.2 Modelling approach

3.2.1 Technical efficiency estimation

Technical efficiency refers to the ability of a decision-making unit (usually a firm) to minimize input used in the production of a given output vector, or the ability to obtain maximum output from a given input vector (Kumbhakar and Lovell, 2003). Consequently, a firm is fully technically efficient if it produces the maximum possible output from a fixed level of inputs (output orientation), or if it uses the minimum possible input to produce a

[3] Bird (1999) also found that most of the manufacturing sectors in Indonesia are characterized by a high degree of industrial concentration.

given level of output (input orientation). There are two well-known methods for estimating the technical efficiency: stochastic frontier analysis (SFA) and data envelopment analysis (DEA).

SFA is a parametric method for estimating firm-or sector-level technical efficiency scores by exploiting the skewness of the error in the specification of a production function (see Aigner *et al.*, 1977; Meeusen and van den Broek, 1977 for details). The approach requires the specification of a functional form and assumptions about the distribution of the efficiency term. DEA (Charnes *et al.*, 1978; Banker *et al.*, 1984) is a non parametric approach to efficiency measurement and requires very few assumptions about the properties of the production possibilities set. DEA uses the frontier concept directly (by projecting the inefficient firm to this frontier) to calculate the technical efficiency score, without assuming a specific functional form for the relationship between inputs and outputs. In addition, DEA takes the most efficient decision-making units (to be 100% efficient) as the basis for calculating technical efficiency for other decision-making units.

Technical efficiency scores are estimated in this paper using DEA for two reasons. First, given that one of the objectives is to infer the direction of causality between efficiency and industrial concentration, time-varying estimates of technical are required. DEA can be applied separately in every subsector of the food and beverages industry and for every year of observed data to provide these estimates[4]. Second, DEA avoids imposing a common structure on the technology of transforming inputs into outputs across subsectors by assuming a common functional form for the production frontier.

[4] Although estimation of efficiency scores with SFA for every year and subsector separately is possible, such an approach would reduce the amount of information required for estimating the parameters of the production function in the dataset. On the other hand, imposing a single production function over the years would lead to autocorrelation of the efficiency score estimates. This autocorrelation could then affect the Granger-causality test that follows.

In general terms, DEA assumes that there are data on *N* inputs and *M* outputs for each of *I* firms. For the *i-th* firm these are represented by the column vectors x_i and q_i, respectively. The *NxI* input matrix, *X*, and the *MxI* output matrix, *Q* represent the data for all *I* firms. This research uses the output-oriented DEA model[5] by solving the mathematical programming problem as in Coelli *et al.* (2005):

$$\begin{aligned} &\max_{\phi,\lambda}\ \phi, \\ &\text{st} \quad -\phi q_i + Q\lambda \geq 0, \\ &\qquad x_i - X\lambda \geq 0, \\ &\qquad I1'\lambda = 1 \\ &\qquad \lambda \geq 0, \end{aligned} \tag{1}$$

where ϕ represents a Farrel measure of technical efficiency (Farrel, 1957) with $1 \leq \phi < \infty$, and $\phi - 1$ is the proportional increase in outputs that could be achieved by the *i*-th firm, with input quantities held constant. λ is an *Ix1* vector of constants and *I1'λ=1* is a convexity constraint, with *I1* being an *Ix1* vector of ones. The convexity constraint is used to impose variable returns to scale (VRS), which ensures that an inefficient firm will only be compared to firms with a similar scale. The assumption of VRS technologies is also relevant because constant return to scale seems a too strong assumption for the Indonesian food and beverages sector, as this sector is characterized by many distortions. Regarding the calculation, if there are 100 firms in a subsector, the DEA frontier will be calculated by solving 100 linear programming problems of the form presented in (1), one for each of the 100 firms in the subsectors. We define $\hat{\delta}(x, y) = 1/\hat{\phi}$ as a measure of technical efficiency that assumes values in the unit interval so that the bootstrap method that follows is well defined.

[5] We use output-oriented DEA to identify technical inefficiency as a proportional increase in output production, with input levels held fixed. This assumption might be relevant in the industry because small and medium firms find some difficulties to access the financial institution in order to expand their business in most of the periods.

To get robust estimates of the efficiency scores, this research uses the bootstrap technique of Simar and Wilson (Simar and Wilson, 1998). This technique is also expected to reduce the serial correlation problem in the efficiency scores among firms. The bootstraping method is repeated simulation of the data generating process, using a resampling method and applying it to the original estimator to the simulated sample so that the simulated estimates mimic the sampling distribution of the original estimator (Simar and Wilson, 1998). As the final result, we provide only the biased-corrected efficiency scores as accurate measure of efficiency, obtained using the formula:

$$\hat{\hat{\delta}}(x,y) = \hat{\delta}(x,y) - \mathrm{bias}_B\left[\hat{\delta}(x,y)\right]$$

$$= 2\hat{\delta}(x,y) - B^{-1}\sum_{b=1}^{B}\hat{\delta}_b^*(x,y) \qquad (2)$$

with the condition of sample variance $\hat{\delta}_b^*(x,y) < \frac{1}{3}\left(\widehat{bias}_B\left[\hat{\delta}(x,y)\right]\right)^2$ *(3)*

In the last two relations $\hat{\delta}(x,y)$ and $\hat{\hat{\delta}}(x,y)$ are the consecutive original and biased-corrected efficiency scores, and $\hat{\delta}_b^*(x,y)$ is the bootstrap estimate of the efficiency score in the b^{th} out of B bootstrap repetitions.

3.2.2 Industrial concentration calculation

Industrial concentration is measured using both the Herfindahl-Hirshman Index (*HHI*) and the concentration ratio for *n* firms (CR_n), which is based on Pepall *et al.* (2008). Both indicators of industrial concentration are based on the market share of the firms and calculated by the following formulas:[6]

[6] Considering stocks, this paper calculates industrial concentration based on sales data because sales seem to explain more about the market share than output.

$$CR4_j = \sum_{i=1}^{4} MS_i \qquad (4)$$

$$HHI_j = \sum_{i=1}^{n} (MS_i)^2 x10000 \qquad (5)$$

where $j = 1,2,\ldots, m$ indexes the subsector, $i = 1,2,\ldots n$ indexes firms within a subsector, and MS_i is the market share of firm *i* in its respective subsector. $CR4_j$ considers the collective share of the four largest firms in subsector *j*, while HHI_j considers the inequality of distribution of market shares among all firms in subsector *j*. Both the *CR4* and the Herfindahl-Hirschman Index (*HHI*) measures have limitations in their calculation, but they complement each other.[7] Hence, it is necessary to use both concentration measures to clearly depict market structure in the industry.

3.3 Technical efficiency-industrial concentration model

To confirm whether there is a relationship between industrial concentration (*MS*) and technical efficiency (*TE*), we use a panel Granger-causality test. Since both *TE* and *MS*, as expressed by *CR4*, are restricted in the unit interval, we take the logistic transformation of the estimated measures of *TE* and *CR4*[8]. The logistic transformation is needed to ensure that the estimates of *TE* will be maintained between 0 and 1 as *MS* increases.

[7] *CR4* is commonly used to classify the market into some categories of oligopoly (Shepherd, 1999), but it cannot capture the distribution of the market share for all firms in the market. On the other hand, *HHI* can capture the distribution of a firm's market share in a market, but it is rather difficult to classify the oligopoly categories from the *HHI*. In spite of this, Besanko *et al.* (2004) gave a classification of market structure based on *HHI*. Furthermore, Liebenberg and Kamerschen (2008) also discussed the importance of using both *HHI* and concentration ratio.

[8] The logistic transformation maps *CR4* or *TE* from the unit interval to the real line by using the invers of the logistic function, $\frac{1}{1+e^{-x}}$. Since *HHI* can assume any positive value and typically is centered away from zero, this variable is not transformed prior to estimation.

A Granger-causality test gives an indication of the direction of the relationship between industrial concentration and technical efficiency. The Granger-causality test is based on the following vector autoregression model (VAR):

$$TE_{jt} = \alpha_j + \sum_{k=1}^{K} \beta_k TE_{j,t-k} + \sum_{k=1}^{K} \gamma_k MS_{j,t-k} + v_{jt} \tag{6}$$

$$MS_{jt} = \lambda_j + \sum_{k=1}^{K} \alpha_k TE_{j,t-k} + \sum_{k=1}^{K} \delta_k MS_{j,t-k} + \varepsilon_{jt} \tag{7}$$

Since we use panel data, we use the Arrellano-Bond (1991) estimator for equations (6) and (7) to control for unobserved heterogeneity using the generalized method of moments (GMM) (Verbeek, 2008). We consider the error term in these two equations as innovations, uncorrelated with past values of the regressors. In this setting the Arrelano-Bond estimator exploits additional moment conditions by using a list of instruments that vary with *t*. The list of instrumental variables consists of the lags of the variables instrumented. These lags are correlated with the endogenous variables, but, under the view of the error terms as innovations, they do not correlate with the error terms. The Granger-causality test uses a Wald test (coefficient-restriction test) on the variables observed. The test gives an indication of whether QL or ES hypothesis applies in the food and beverages industry.

To examine the relationship between the industrial concentration and technical efficiency, a panel-data model is built based on the results of the Granger-causality test, as follows:

$$y_{jt} = \alpha_j + \beta x'_{jt} + u_{jt} \tag{8}$$

where j and t index subsector and time, respectively. Variables y and x are industrial concentration (*MS*) and technical efficiency (*TE*). Based on the Granger-causality test, eq. (8) can only be a single model confirming true direction of causality as stated in QL or ES hypothesis. For example, if the Granger-causality test supports the QL hypothesis, then eq. (8) is used to determine the concurrent effect of industrial concentration on technical efficiency. Otherwise, eq. (8) is specified such that the effect of technical efficiency on industrial concentration is determined. From eq. (8), we hypothesize that if the QL hypothesis applies to the industry, then *MS* has a negative effect on *TE*, whereas if the ES hypothesis applies to the industry, then *TE* has positive effect on *MS*. We account for endogeneity in eq. (8) using the method described in Clarke and Davies (1982) and Gumbau-Albert and Maudos (2002), i.e. we use instrumental variables for eq. (8) to deal with the endogeneity problem.

3.4 Data and variables measures

This research uses firm-level data to estimate efficiency scores and generate industrial concentration measures in each subsector of the food and beverages industry. The data are obtained from the Annual Manufacturing Survey provided by the Indonesian Bureau of Central Statistics (BPS). The dataset covers the period from 1995 to 2006 for which the data are tractable and comparable for all subsectors among the years. Furthermore, data beyond 2007 have not yet been published.

Regarding the technical efficiency estimation, we use 33 subsectors at the 5-digit level of International Standard Industrial Classification (ISIC) system[9]. The 33 subsectors contain more than 30 firms, on average, in the period from 1995 until 2006. Considering the small samples, we use only the subsectors with sufficient observations. For the remaining subsectors, those that have less than 30 observations, are combined at the 4-digit ISIC level.

[9] Actual codes used are not the ISIC codes, but comparable, coming from Klasifikasi Baku Lapangan Usaha Indonesia (KBLI). There are 59 subsectors in the food and beverages industry classified into the 5-digit ISIC level, 55 of which are related to the food processing, with the remaining to the beverages industry. We use only 33 out of 59 subsectors because the remaining subsectors have less than 30 observations on average during the period 1996-2006. In our case, we find that DEA does not estimate valid technical efficiency scores for the subsectors which have less than 30 observations, on average.

Therefore, there are 6 (six) new subsector names of the 33 subsectors, which are the combination of some subsectors.[10]

The food and beverages industry uses raw material, labor, and fixed capital such as machinery, equipment, etc. to produce the finished good. Output is defined as value of gross output produced by establishment every year and deflated by the wholesale price index of food and beverages (WPI). Labor efficiency units are used as a proxy for labor[11]. Raw material is the total costs of domestic[12] and imported raw materials and is deflated by the wholesale-price index (WPI) of raw materials for food and the official WPI for imported raw food published by the BPS. We define fixed capital as fixed assets, deflated by the WPI of machinery (excluding electrical products), transport equipment, residential, and non residential buildings.

Table 3.1 shows the descriptive statistics of the variables used in the research. It is observed that the average of *CR4* is 0.482, which characterizes the food and beverages sector as an oligopoly, according to the criteria of Shepherd (1999) and Besanko *et al.* (2004). The coefficients of variation of the input (material, labor, and capital) and output variables among the subsectors of the food and beverages industry are quite high. This suggests big differences in the size of the firms and the technologies used between subsectors.

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[10] The 6 (six) new subsectors are derived by combining subsectors with insufficient observations in the following way: 15113 = 15111+15112 ; 15130 = 15131+…+15134+15139 ; 15210=15211+…+15213 ; 15319 = 15312 + 15314+…+15318 ; 15320 = 15321 + 15324+ 15329 ; 15420 = 15422+15423+15424+15429

[11] We modify the formula for labor efficiency units used by Tybout and Westbrook (1995) as:

$$\text{L} = \text{number of production workers} + \text{number of other workers} * \left(\frac{\text{salary of other worker}}{\text{salary of production worker}}\right)$$

[12] Domestic raw materials also include other costs related to the production such as electricity and fuel cost.

Table 3.1 Descriptive statistics of the variables from 1995-2006

Variable	Mean	Standard Deviation	Coefficient of Variation	Maximum	Minimum
CR4	0.482	0.220	0.457	0.967	0.081
HHI	1217.736	1219.341	1.001	7441.578	51.465
Material (in Millions Rupiah)	185.259	1254.719	6.773	127257.103	0.102
Labor (Person Index)	171.845	1281.995	7.460	167086.381	4.000
Capital (in Millions Rupiah)	1901.208	65435.776	34.418	7321000	0.099
Output (in Millions Rupiah)	225.270	1372.521	6.093	74304.753	2.113
Size (Log of Value Added))	14.733	1.620	0.109	18.498	10.224
Growth of Value Added	0.352	0.943	2.679	6.466	-0.863
Capital-output ratio (*COR*)	0.023	0.210	9.130	$3.69 \cdot 10^{-4}$	3.937
N-Subsectors	33	33	33	33	33

Notes: CR4 = Concentration ratio for four firms

HHI = Herfindahl-Hirschman index

COR = Capital-output ratio

Source: Indonesian Bureau of Central Statistics and Author's calculation

3.5 Empirical model and results

3.5.1 Technical efficiency and industrial concentration

Table 3.2 shows both the average biased-corrected technical efficiency scores and industrial concentration measures for subintervals of the period covered by the data. The results show that, along the period, there is no clear path of the relationship between industrial concentration and efficiency. The efficiency score as well as the industrial concentration are relatively stable, except for the period from 1998-2000. During the period of economic crisis (1997-1998), there are many firms exiting the industry, which may explain the increase in industrial concentration and technical efficiency.

Furthermore, Table 3.2 shows that the sectors in the food and beverages industry are relatively inefficient in the period of estimation. During the period 1995 to 2006, the average technical efficiency score is 0.550, which means that the firms in subsectors of the food and beverages industry, on average, exploit 55% of their production potential. Based on the data, the subsector "other foods from soybean and nuts" (15495) has the highest technical efficiency, whereas the subsector "processed tea and coffee" (15491) has the lowest technical efficiency[13]. The average technical efficiency of the Indonesian food and beverages sector is close to the technical efficiency score of 0.413 found by Ikhsan (2007) over the period from 1988 to 2000. Furthermore, similarly low technical efficiency scores were found in other Asian countries. Ismail (2009), for example, reported that the technical efficiency score in the Malaysian food and beverages industry is between 0.349 and 0.617 in the period 1985-2003.

Table 3.2 Technical efficiency score and industrial concentration

Period	**Average Biased-Corrected Technical Efficiency Score**	***CR4***	***HHI***
1995-1997	0.552	0.445	1027.500
1998-2000	0.567	0.534	1414.497
2001-2003	0.539	0.475	1139.045
2004-2006	0.543	0.475	1289.903
1995-2006	0.550	0.482	1217.736

Notes: CR4 = Concentration ratio for four firms
HHI = Herfindahl-Hirschman index
Source: Authors' calculation

The distribution of market shares, as captured by the *HHI*, changes overtime during the period from 1995 to 2006. The average is 1217.736, and its volatility reflects the dynamics of competition among firms in the subsectors of the food and beverages industry. Although there might be a dynamic competition, the concentration ratio of four firms (*CR4*) is still high in the subsectors, with an average of 0.482 in the period from 1995 to 2006. This value of industrial concentration classifies the food and beverages industry into an oligopoly.

[13] The technical efficiency score for each sector, as well as, the confidence intervals of the biased-corrected technical efficiency score are presented in the appendix Table A.1.

3.5.2 Model estimation

Granger-causality test

To investigate whether the QL or ES hypothesis applies to the Indonesian food and beverages industry, we employ the Granger-causality test within a vector autoregression model with Arrelano-Bond estimation approach. The Akaike information criterion (AIC) suggests that two lags are appropriate. Using the stationarity test of Levin, Lin, Chu (LLC) (2002), we find that both industrial concentration and technical efficiency are stationary at the 5% critical level, so the Granger-causality test is based on the level form of the variables. Table 3.3 shows the results of the Granger-causality test.

Table 3.3 VAR Granger-causality/block exogeneity Wald tests

Independent Variables	Dependent Variables		
	Average Biased-Corrected Technical Efficiency Score	*CR4*	*HHI*
Excluded	Chi-sq	Chi-sq.	Chi-sq.
CR4	88.591***		
HHI	8.622**		
Average Biased-Corrected Technical Efficiency Score		0.577	1.995

Notes: ** denotes test statistic significance at the 5% level

*** denotes test statistic significance at the 1% level

CR4 = Concentration Ratio for Four Firms

HHI = Herfindahl-Hirschman Index

Source: Authors' calculation

The Granger-causality test also suggests that the efficient-structure hypothesis does not apply to the food and beverages industry. As shown by Setiawan *et al.* (2012), the industrial concentration of all subsectors in the food and beverages industry converge to the same value in the long run, where the subsectors with high industrial concentration (they might becoming inefficient or no room for improvement) will have lower industrial concentration and the subsectors with low industrial concentration (they might becoming efficient) will have higher industrial concentration in the long run. Also, Alam and Morrison (2000) argued that firms with a relatively low efficiency have greater scope for improvement. This implies that the increase in technical efficiency in the subsectors with low concentration does not contribute much to the increase of industrial concentration.

Panel data estimation

The panel data model is employed to provide an additional test on the applicability of the QL hypothesis to the Indonesian food and beverages, i.e. to test whether industrial concentration has a negative impact on technical efficiency. We use a fixed-effects model in the panel data regression since the random-effects model was rejected by the Hausman (1978) test. The White test for heteroscedasticity rejects the null hypothesis of absence of heteroscedasticity at the 5% critical level. To address the problem of heteroscedasticity, this paper applies the generalized least squares (GLS) method. The instrumental variables for industrial concentration are chosen based on Mueller and Hamm (1974), Khalilzadeh-Shirazi (1974), Gupta (1983), Prince and Thurik (1992), Kalirajan (1993), Go *et al.* (1999), Delorme *et al.* (2002), and Setiawan *et al.* (2012). The main instrumental variables estimating the industrial concentration are industry size (size of value added), growth of demand (growth of value added), and capital-output ratio (*COR*). The results of the panel data model estimation are presented in Table 3.4.

From the results of Table 3.4 we can observe that the QL hypothesis applies to the food and beverages industry. The higher industrial concentration lowers technical efficiency in the subsectors of the industry. This relationship is shown by the negative coefficients of -1.139 and -0.048 for *CR4* and *HHI*, respectively. Since the variables used in the model are obtained through the logistic transformation of the technical efficiency and *CR4* variables, there is not direct interpretation of the magnitude of the coefficient estimates[14]. The R^2 for both models are relatively low because they resulted from a two-stage least squares regression.

Table 3.4 Regression of industrial concentration on technical efficiency

Independent Variable	Dependent Variable : Average Biased-Corrected Technical Efficiency Score	
	Coefficients	**Coefficients**
Intercept	1.336***	0.692***
	(0.255)	(0.026)
CR4	-1.139***	
	(0.413)	
HHI		-0.048**
		(0.021)
R^2	0.124	0.111
F-statistics	10.918***	12.383***

Notes: ** denotes test statistic significance at the 5% level Standard error in the parentheses
*** denotes test statistic significance at the 1% level
CR4 = Concentration ratio for four firms
HHI = Herfindahl-Hirschman index
Source: Authors' calculation

Based on the fixed-effect coefficients (i.e. the subsector-specific intercepts) of *TE* model with the *CR4* and *HHI* measures (see appendix Table A.2), some subsectors are, ceteris paribus, indicated as more efficient than others. For example, subsector “wheat flour, sago, and other starch nec.” (15320); subsector “other foods from soybean and nuts” (15495); and “soya sauce” (15493) are more efficient than the rest of the subsectors. Looking at the subsector characteristics, the difference in the efficiency between subsectors may be caused by some unique factors of the subsectors such as the level of technology, basic processing vs.

[14] Nevertheless, since the logistic transformation is one-to-one, the negative relationship between industrial concentration and technical efficiency can be interpreted directly. Furthermore, *HHI* in the model is defined as *HHI*/1000 to minimize the reported decimal points in the *HHI* coefficients.

high level processing, managerial ability, economies of scale, and advertising expenses[15]. In addition, it is also found that the subsectors that are among the higher concentrated have a higher technical efficiency[16], indicating that for these subsectors, the degree of concentration is not a very good predictor of technical efficiency. Instead, the difference in technical efficiency is captured in the model by the fixed-effect coefficients, which again is not surprising because the fixed-effect parameters account for unobserved heterogeneity, such as different characteristics of the subsectors and scale effects, as discussed previously.

A negative effect of industrial concentration on technical efficiency is also found in Gumbau-Albert and Maudos (2002) and Al-Muharrami and Matthews (2009). Moreover, Setiawan *et al.* (2012) found that industrial concentration affects the price-cost margin in the Indonesian food and beverages industry positively. Although the latter may suggest there is a high degree of allocative inefficiency, another study by Kalirajan and Shand (1992) found that allocative efficiency is affected by technical efficiency. Therefore, since higher industrial concentration causes inefficiency in the food and beverages industry, we come to the conclusion that cartels and collusion lead to higher industrial concentration and technical inefficiency.

3.6 Conclusions and policy implications

This paper estimates technical efficiency and industrial concentration in the Indonesian food and beverages sector. Moreover, this paper contributes to the literature by applying the concept of Granger-causality to find whether the quiet-life or the efficient-structure

[15] See Gujarati (2003) who discussed the possible unique factors causing the difference in the fixed effect coefficients between firms.

[16] For example, sub sector wheat flour, sago, and other starch nec. (15320) has higher industrial concentration than other subsectors, but it also has higher technical efficiency.

hypothesis applies to the Indonesian food and beverages industry. Furthermore, this paper analyzes the relationship between technical efficiency and industrial concentration in the food and beverages sector in Indonesia.

We observe that industrial concentration in the Indonesian food and beverages industry is relatively high. The industry is also found to be inefficient over the period under consideration. Furthermore, we found evidence in support of the quiet-life hypothesis (QL hypothesis) in the industry, suggesting that a higher industrial concentration decreases technical efficiency. This finding implies that firms in highly concentrated industries gain more price-cost margin through cartel or anticompetitive practices rather than from efficiency gains. Therefore, maintaining such an oligopolistic structure in the industry creates a distortion, which implies a waste of resources in the Indonesian economy.

Regarding the research findings, the industrial policies should aim at increasing competition and promoting free entry in the industry to lower the high industrial concentration. Lowering the high industrial concentration would lead to an increase in the efficiency of the industry, which may affect the product quality and price to the consumer. Furthermore, reviewing the competition law as well as increasing the law enforcement should be considered to break more cartels or other anticompetitive practices. The result of the Granger-causality test, which rejects the efficient structure hypothesis for the industry under consideration, casts doubts on arguments in favor of allowing firms to grow in size in order to exploit economies of scale.

Finally, since previous research found that other manufacturing sectors in the Indonesian economy are characterized by high industrial concentration, future research using the robust methods proposed in this paper may be relevant to provide information on whether the QL or ES-hypothesis applies to these sectors. Results obtained through this research could provide appropriate policy recommendations on a sector-by sector basis.

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Appendix

Table A.1
Biased-Corrected Technical Efficiency Scores and Confidence Intervals
Period 1995-2006

Subsector	Biased-Corrected Technical Efficiency	95%-Lower Confidence Interval	95%-Upper Confidence Interval
15113	0.685	0.463	0.906
15121	0.624	0.363	0.884
15122	0.479	0.204	0.755
15124	0.514	0.305	0.723
15125	0.733	0.493	0.973
15129	0.727	0.428	1.000
15130	0.554	0.393	0.715
15141	0.486	0.190	0.781
15143	0.670	0.400	0.941
15144	0.675	0.417	0.932
15210	0.600	0.285	0.915
15311	0.594	0.258	0.930
15313	0.461	0.021	0.901
15319	0.482	0.200	0.764
15320	0.707	0.472	0.942
15322	0.606	0.165	1.000
15323	0.544	0.285	0.804
15331	0.534	0.333	0.736
15410	0.347	0.184	0.510
15420	0.575	0.307	0.843
15421	0.516	0.298	0.734
15432	0.528	0.294	0.761
15440	0.376	0.073	0.679
15491	0.258	0.040	0.477
15492	0.505	0.337	0.673
15493	0.539	0.183	0.896
15494	0.619	0.434	0.803
15495	0.767	0.575	0.960
15496	0.411	0.198	0.623
15497	0.640	0.292	0.989
15498	0.607	0.308	0.906
15499	0.401	0.130	0.673
15540	0.391	0.132	0.650

Source: Authors' calculation

Tabel A.2

Ordered Fixed Effect Coefficients of Technical Efficiency (TE) Model

TE model With CR4 Measure		**TE Model with HHI Measure**	
Variable	**Coefficients**	**Variable**	**Coefficients**
Constant	1.336	Constant	0.692
Subsector Code	**Fixed Effect**	**Subsector Code**	**Fixed Effect**
15320	0.134	15320	0.151
15495	0.099	15493	0.114
15493	0.090	15130	0.107
15130	0.081	15495	0.076
15143	0.078	15125	0.068
15129	0.076	15143	0.061
15420	0.071	15420	0.056
15497	0.066	15129	0.055
15210	0.058	15113	0.040
15113	0.057	15497	0.025
15144	0.043	15498	0.023
15322	0.040	15210	0.021
15498	0.028	15322	0.019
15121	0.027	15144	0.017
15319	0.016	15121	0.013
15499	0.001	15319	0.003
15313	0.001	15499	-0.004
15125	-0.005	15494	-0.015
15432	-0.019	15313	-0.026
15331	-0.022	15331	-0.030
15124	-0.037	15432	-0.031
15494	-0.037	15124	-0.034
15122	-0.046	15323	-0.042
15421	-0.049	15122	-0.046
15440	-0.049	15311	-0.046
15323	-0.055	15421	-0.046
15540	-0.069	15141	-0.055
15141	-0.076	15440	-0.057
15311	-0.079	15492	-0.065
15410	-0.083	15540	-0.071
15491	-0.093	15410	-0.082
15496	-0.109	15496	-0.084
15492	-0.111	15491	-0.094

Notes: CR4 = Concentration Ratio for Four Firms
HHI = Herfindahl-Hirschman Index

Source: Authors' calculation

Chapter 4

Price Rigidity and Industrial Concentration: Evidence from the Indonesian Food and Beverages Industry

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Abstract

This paper investigates the relationship between industrial concentration and price rigidity in the Indonesian food and beverages industry. A Cournot model of firm behavior is used in which prices adjust according to a partial adjustment mechanism. The model is applied to panel data of the Indonesian food and beverages industry over the period 1995-2006. The results suggest that industrial concentration has a positive effect on percentage price changes. Furthermore, the speed of price adjustment is positively related to industrial concentration when the per unit cost of production goes up, especially in concentrated subsectors.

Keywords: price rigidity, industrial concentration, speed of price adjustment, oligopoly structure, food and beverages industry

4.1 Introduction

Price rigidity is defined as the condition where some prices adjust slowly in response to changes in per unit cost of production or changes in supply or demand[1]. It is one of the most important economic issues as rigidity of prices can cause inefficiency in the allocation of resources (Carlton, 1986). An important factor influencing price rigidity is the degree of industrial concentration (see Stigler, 1947; Carlton, 1986; Bedrossian and Moschos, 1988; Caucutt *et al.*, 1999). A few large firms operating in an industry characterized by high industrial concentration may use market power to control the price level, as well as, variations in the price level.

Several studies have examined the relationship between price rigidity and industrial concentration, but the results are inconclusive. Means (1935) hypothesized that market

[1]The concept of the kinked demand curve was introduced by Sweezy (1939) who defined price rigidity as slow price adjustment with respect to the other competitors' strategy.

structure can affect pricing behaviour[2], but this hypothesis was rejected by Neal (1942) and Aaronovitch and Sawyer (1981), suggesting that industrial concentration has no effect on price rigidity. Although some researchers rejected Means' hypothesis, research conducted by Weiss (1995), Bedrossian and Moschos (1988), and Caucutt *et al.* (1999) showed that industrial concentration is an important factor in explaining price rigidity.

Price rigidity is also present when the demand curve is kinked (Sweezy, 1939), implying that the decreases in prices are more likely than increases in response to the actions of competitors. Stigler (1947) though stated that explicit anticompetitive practices between a few large firms in highly concentrated industries cannot cause a kinked demand curve. Also Stigler and Kindahl (1970) hypothesized that the only source of price flexibility is upward price movement. Furthermore, Phlips (1969) suggested that upward price flexibility behaves in the same way for both highly concentrated and slightly concentrated industries and argued that an increase in the unit cost of production is followed by an increase in price. In addition, Phlips (1980) argued that industrial concentration affects price indirectly through cost changes. Finally, Bedrossian and Moschos (1988) found that the speed of price adjustment is positively correlated with industrial concentration.

This paper develops a new theoretically-founded model to explain the relationship between industrial concentration and price rigidity in the Indonesian food and beverages industry. The model also captures the price adjustment in response to cost increases or decreases. The Indonesian food and beverages industry is characterized by a high price-cost margin and technical inefficiency, and a high industrial concentration, with some sectors consisting of only a few large firms (see Setiawan *et al.*, 2012a, b). A priori it is expected that firms in this highly concentrated food and beverages industry can use their market power to

[2]Means used the term of "administered price" as the price that does not change frequently in the oligopoly structure because of market power.

maintain the high price-cost margin and that they can create upward price flexibility when cost increases, but downward price rigidity when cost decreases (see Adji, 1996; Solikin and Sugema, 2004; Hutabarat, 2006; and Central Bank of Indonesia, 2009). From a policy perspective, downward price rigidity could lead to significant welfare losses and, therefore, should be targeted by policy makers. Also this investigation would help the Indonesian government and Central Bank in identifying sectors that are more likely subject to price rigidity. Monitoring these sectors more intensively may improve the effectiveness of the inflation policy of the Indonesian government.

Pricing in the food and beverages industry affects the entire Indonesian economy significantly because this sector represents a large share of the country's GDP and total value of industrial production[3]. To date, hardly any research has been conducted into the relationship between industrial concentration and price rigidity in the Indonesian food and beverages industry. Adji (1996) used data from other manufacturing industries to investigate the relation between industrial concentration and price change, whereas Solikin and Sugema (2004) investigated price rigidity for the entire Indonesian economy.

The remainder of this paper is organized as follows. Section 2 provides the approach to measuring price rigidity and industrial concentration and for modeling their relation. This is followed by the description of the data in section 3 and the discussion of the results of the empirical estimation in section 4. The last section presents conclusions and policy implications.

[3]Since 2004, the output of this sector accounted for about 7% of the GDP and about 23% of the total industrial manufacturing output. Additionally, the food and beverages sector absorbed about 23% of total employment in the Indonesian manufacturing industry in 2006, and employment in the industry grew significantly (about 19%) in 2006 compared to 2005.

4.2 Price rigidity and industrial concentration

To measure price rigidity relating with industrial concentration, this research uses a partial adjustment model to determine the speed of price adjustment as a measure of price rigidity. The partial adjustment model was first introduced by Nerlove (1958) and assumes that the adjustment of a variable to an equilibrium is likely to be incomplete, e.g. due to the presence of factors that cause rigidity. Therefore, the speed of price adjustment will provide evidence of price rigidity. The partial adjustment model is specified as:

$$P_t - P_{t-1} = \lambda(P_t^* - P_{t-1})\,;\, 0 \le \lambda \le 1 \qquad (1)$$

where P_t is the actual price in period t, P_t^* is the desired or equilibrium price level, and λ captures the speed of price adjustment. Although the partial adjustment model has been used by other researchers to explain price rigidity (see Shaanan and Feinberg, 1995 and Bedrossian and Moschos, 1988), their models did not explicitly include a behavioral model under an oligopoly structure.

To establish the relationship between the speed of price adjustment and industrial concentration, this research uses the equilibrium price suggested by the Cournot model of pricing[4]. The Cournot model fits with the conditions of the Indonesian food and beverages industry, since this industry is characterized by an oligopoly structure and imperfect information (see Setiawan *et al.*, 2012a, b). Following the Cournot model of pricing, the Nash equilibrium is used as the desired or equilibrium price level. We start from the inverse demand function for the output of a given subsector:

$$P^* = \alpha - \beta\left(Q_{-i} + q_i\right) \qquad (2)$$

[4]The Cournot model assumes that the firms influence the price through their strategies in output markets, which is also assumed to be the only source of price control in this study.

where Q_{-i} is the subsector's output excluding output from firm *i* (q_i). Profit maximizing behaviour for firm *i* with different marginal costs among firms (c_i) results in:

$$P^* - c_i = \beta q_i \tag{3}$$

Multiplying and dividing the right-hand side of (3) by the subsector's total output yields:

$$P^* - c_i = \beta Q \cdot MS_i \tag{4}$$

where MS_i is the market share of firm *i*. By multiplying each side of (4) by MS_i and adding across all *N* firms in the subsector we obtain:

$$\sum_{i=1}^{N} MS_i (P^* - c_i) = \beta Q \sum_{i=1}^{N} MS_i^2 \tag{5}$$

$$P^* - \bar{c} = \beta Q \cdot HHI \tag{6}$$

$$P^* = \beta (Q \cdot HHI) + \bar{c} \tag{7}$$

where $\bar{c}$ is the weighted (by market share) average per unit cost of production, and *HHI* is the Herfindahl-Hirschman Index. Substituting (7) into (1) and pooling all subsectors in one model yields:

$$P_{jt} = \lambda\beta (Q \cdot HHI)_{jt} + \lambda \bar{c}_{jt} + (1-\lambda) P_{j,t-1} \tag{8}$$

where *j* indexes subsectors. Since λ appears directly in three places in the model, we can rewrite (8) as:

$$\Delta P_{jt} = \lambda\beta HHI^*_{jt} + \lambda(\bar{c}_{jt} - P_{j,t-1}) \tag{9}$$

where HHI^* is the interaction between total subsector output and the Herfindahl-Hirschman index. Equation (9) is expressed in percentage terms of price change yielding the following expression:

$$\frac{\Delta P_{jt}}{P_{j,t-1}} = \lambda\beta \left(\frac{Q_{jt}}{P_{j,t-1}} \cdot HHI_{jt}\right) + \lambda \left(\frac{\bar{c}_{jt} - P_{j,t-1}}{P_{j,t-1}}\right) \tag{10}$$

Since $\beta = -\frac{\partial P_{jt}}{\partial Q_{jt}}$,the term $\beta(\frac{Q_{jt}}{P_{j,t-1}})$ can be viewed as an approximation to the inverse of the elasticity of demand, $\frac{1}{\varepsilon_{Q,P}}$. Additionally, the variable $\frac{\bar{c}_{jt} - P_{j,t-1}}{P_{j,t-1}}$ can be viewed as an approximation to the negative of a Lerner index (*L*).

In the empirical model, subsector-specific dummies are added to equation (10) in order to account for unobserved heterogeneity among subsectors. Moreover, in order to investigate the difference in price adjustment for cost increases versus cost decreases, a dummy variable is added. This dummy variable allows for a different speed of price adjustment for upward and downward movements in the unit cost of production. This results in the following econometric model:

$$\frac{\Delta P_{jt}}{P_{j,t-1}} = \gamma_j + \lambda\beta(\frac{Q_{jt}}{P_{j,t-1}} \cdot HHI_{jt}) + \lambda(\frac{\bar{c}_{jt} - P_{j,t-1}}{P_{j,t-1}}) + \theta_1 DCUP \cdot (\frac{Q_{jt}}{P_{j,t-1}} \cdot HHI_{jt})$$
$$+ \theta_2 DCUP \cdot (\frac{\bar{c}_{jt} - P_{j,t-1}}{P_{j,t-1}}) + \varepsilon_{jt} \qquad (11)$$

Equation (11) is then written as:

$$\%\Delta P = \gamma_j + \lambda\beta(HHI^*_{jt}) + \lambda(C-P)_{jt} + \theta_1 DCUP \cdot (HHI^*_{jt}) + \theta_2 DCUP \cdot (C-P)_{jt} + \varepsilon_{jt} \qquad (12)$$

where *HHI** is $\left(\frac{Q_{jt}}{P_{j,t-1}} \cdot HHI\right)$, *(C-P)* is $\left(\frac{\bar{c}_{jt} - P_{j,t-1}}{P_{j,t-1}}\right)$, *DCUP* is 1 if a cost increase relative to the previous period occurs and 0 otherwise. Equation (12) is used to estimate the speed of price adjustment, λ, which is assumed to be constant over a period of cost and price change. This equation is estimated for the whole food and beverages industry and for subsectors with different degrees of industrial concentration. Doing so, allows for testing for differences in the speed of price adjustment. Following the USA September 1992 Merger Guidelines, this research classifies the groups of firms as[5]: unconcentrated ($HHI \leq 0.1$), moderately concentrated ($0.1 < HHI \leq 0.18$), and highly concentrated ($HHI > 0.18$).

4.3 Data

This research uses firm-level (establishment) data to estimate industrial concentration in each subsector of the food and beverages industry. The data are obtained from the Annual Manufacturing Survey provided by the Indonesian Bureau of Central Statistics (BPS). The dataset covers the period 1995-2006 for which the data are tractable and comparable for all subsectors among the years. This research uses 59 subsectors of the food and beverages industry, classified into 5-digits of the International Standard Industrial Classification (ISIC) level[6]. Estimation of the speed of price adjustment is conducted at the 4-digit rather than the 5-digit ISIC level in order to maintain a sufficient number of observations per subsector[7].

The percentage of price change is measured as the percentage change of the price index of the products in each subsector of the food and beverages industry. The price index is deflated by the consumer price index of food and beverages products (base year 2000) in order to eliminate the effect of inflation. The actual price is transformed into a price index because each subsector has different units of measurement for different products. Total

[5]The original classification from the USA September 1992 Merger Guidelines uses HHI unit as 1000 instead of 0.1.

[6]Actual codes used are not the ISIC codes, but comparable, coming from Klasifikasi Baku Lapangan Usaha Indonesia (KBLI). There are 59 subsectors in the food and beverages industry classified into 5 digit of ISIC level, 55 of which are related to the food processing, with the remaining to the beverages industry.

[7]The use of the 4-digit ISIC level rather than the 5-digit can increase the number of observations for some subsectors in the model because it can pool some subsectors with 5-digit ISIC level in 4-digit ISIC level. However, the 4-digit ISIC level of the food and beverages industry still represents firms with relatively similar production processes. Also regarding the limitation of the data, this research assumes a symmetric effect of product differentiation on the pricing behaviour in each subsector.

output for each subsector is defined as the value of output produced every year and divided by the annual subsector price index of the food and beverages industry (base year 2000). Unit cost is the per unit variable cost for each subsector of the food and beverages industry, deflated by the consumer price index with base year 2000.

Table 4.1 shows the descriptive statistics of the data used in this research. It is shown that the average price is 0.993 which varies between 0.277 and 2.800; the per unit cost varies between 0.130 and 2.989 with an average of 0.989. The variation of unit cost is larger than the variation of price (0.458 and 0.354, respectively). Furthermore, the variation of the % price change is very high (4.307) with the average of the % price change being 7.074%. Therefore, it is expected that there is low price rigidity in the food and beverages industry, on average.

Table 4.1 Descriptive statistics of the variables from 1995-2006 across subsectors

Variable	Mean	Standard Deviation	Coefficient of Variation	Minimum	Maximum
Unit cost	0.989	0.458	0.463	0.130	2.989
HHI	0.267	0.254	0.951	0.005	1.000
Price	0.993	0.354	0.356	0.277	2.800
% change of price	7.074	30.466	4.307	-54.400	188.000
Total Output (Million Rupiah)	206305.722	556413.151	2.697	39.716	$7.360 \cdot 10^5$
N-Subsectors	59	59	59	59	59

Source: Authors' calculation

From the Table 4.1 it is also seen that the average *HHI* is 0.267, which characterizes the food and beverages sector as highly concentrated, according to the criteria of USA September 1992 Merger Guidelines. Furthermore, the data show that the *HHI* and total quantity among subsectors vary significantly, with the coefficients of variation being 0.951 and 2.697, respectively.

4.4 Results

Tables 4.2 and 4.3 present the empirical results of the estimation of the model in (12) on the relationship between % price change, per unit cost, and industrial concentration. The results are obtained after accounting for heteroscedasticity using the White-heteroscedasticity-consistent estimator. The Hausman (1978) test suggests that the random effects model is rejected in favor of the fixed effects model at the 5% and 10% critical level for the model representing the whole food and beverages industry and for all models of the individual subsectors[8].

From Table 4.2, it is concluded that the interaction variable of industrial concentration and total output has a positive effect on the price change in the industry model at the 5% critical level. The coefficient of *HHI** in Table 4.2 suggests that an increase of *HHI** by one unit, increases the % price change by 0.7%, *ceteris paribus*. The effect of the *HHI** on the % price change when costs increase is significantly higher (by 1.8%) than when the costs decrease (*DCUP·HHI**). To get the pure effect of industrial concentration on the % price change for each subsector, we have to take compute the marginal effect of *HHI*. On the % price change equation (12) suggests a positive marginal effect of industrial concentration, since the estimates of $\lambda\beta$ when the costs decrease (*HHI**) and when the costs increase (*DCUP·HHI**) are positive with coefficients of 0.007 and 0.025, respectively. Therefore, it is concluded that industrial concentration has a positive effect on the % price changes.

[8]Also a Wald test employed to test the coefficient differences of $\lambda\beta$ and λ among subsectors suggested a common coefficient in the models at the 10% level of significance.

Table 4.2 Regression of industrial concentration and price change

Independent Variable	Dependent Variable : *%ΔPrice*
	Industry Model
	Coefficient
Intercept	-1.202***
	(0.974)
*HHI**	0.007**
	(0.003)
(C-P)	0.125***
	(0.01)
DCUP·(C-P)	0.115***
	(0.021)
*DCUP·HHI**	0.018***
	(0.003)
R^2	0.407
F-statistics	7.154***

Notes: Standard error in the parentheses

** denotes test statistic significance at the 5% level

*** denotes test statistic significance at the 1% level

Source: Author's calculation

The speed of price adjustment (coefficient of *C-P*) is estimated at 0.125 and is almost double (0.240) when costs increase than when they decrease. This implies that prices adjust such that roughly 12.5% of the gap between actual and equilibrium prices is covered per year, with the adjustment being significantly faster when costs increase (roughly 24%).

Table 4.3 presents parameter estimates from the models on subsectors classified as unconcentrated, moderately concentrated, and highly concentrated. The results show that the *HHI** affects the % price change significantly only in the moderately and highly concentrated subsectors with the coefficients of 0.007 and 0.010, respectively. *HHI** has a significant effect on the % price change when costs increase rather than decrease for all groups showed by the coefficients of *DCUP·HHI**. These results suggest that industrial concentration has a positive effect on the % price change. Although the speed of price adjustment is significant for all models as shown by the coefficients of *(C-P)*, the speed of price adjustment is still quite low, especially when the costs go down.

Table 4.3 Regression of industrial concentration on price change

Independent Variable	Dependent Variable : %ΔPrice		
	Unconcentrated	Moderately Concentrated	Highly Concentrated
	Coefficient	Coefficient	Coefficient
Intercept	-1.371	-3.909*	-0.260
	(1.857)	(2.120)	(1.171)
HHI*	0.002	0.007*	0.010**
	(0.003)	(0.004)	(0.004)
(C-P)	0.180***	0.113***	0.109***
	(0.020)	(0.032)	(0.013)
DCUP·(C-P)	0.002	0.111**	0.218***
	(0.038)	(0.056)	(0.032)
DCUP·HHI*	0.029***	0.015**	0.012**
	(0.007)	(0.006)	(0.005)
R^2	0.480	0.399	0.413
F-statistic	8.259***	5.767***	6.964***
N	15 subsectors	13 subsectors	31 subsectors

Notes: * denotes test statistic significance at the 10% level Standard error in the parentheses

** denotes test statistic significance at the 5% level

*** denotes test statistic significance at the 1% level

Source: Author's calculation

The speed of price adjustment is significantly higher when costs increase than when they decrease in the moderately and highly concentrated subsectors with coefficients of 0.113 and 0.109 (significant at the 5% and 1% critical levels, respectively) when the costs go down and the coefficients increase by 0.111 and 0.218 when the costs go up, respectively. The highly concentrated subsectors have the largest speed of price adjustment when costs go up with the coefficient of 0.327 or different by 0.218 from the situation when the costs go down (0.109). This implies that prices adjust such that roughly 10.9% of the gap between actual and equilibrium prices is covered per year, with the adjustment being significantly faster when costs increase (about 33%) in the highly concentrated industry. Nevertheless, the moderately and highly concentrated subsectors do not have a significantly different speed of price adjustment when costs go down with coefficients (associated with *C-P* in Table 4.3) of 0.113 and 0.109, respectively.

Furthermore, the unconcentrated subsectors have no significant difference in the speed of price adjustment when costs go up and down with coefficients of 0.180 and 0.182, respectively (at the 10% critical level). This suggests that the competitive structure leads to a symmetric adjustment in price in response to changes in cost. In spite of this, the unconcentrated subsectors have the largest speed of price adjustment when costs go down compared to the concentrated subsectors, with a point estimate of 0.180.

Table 4.4 presents the speed of price adjustment consistent with (12) for each subsector using the 4-digit ISIC level. From this table, it is seen that there is tendency for most subsectors with moderate and high industrial concentration ($HHI>0.1$) to have a lower speed of price adjustment when the costs go down and to have higher speed of price adjustment when costs go up. For the unconcentrated subsectors ($HHI\leq 0.1$) there is not clear pattern for speed of price adjustment in response to cost increases or decreases. For the unconcentrated subsectors “Prepared Animal Feed” and “Bakery Products”, the speed of price adjustment is higher when costs go up than when they go down and the reverse holds for the two other unconcentrated subsectors “Macaroni, Noodles etc.” and “Soft Drinks etc.”.

Table 4.4 Speed of price adjustment of subsectors in 4 digit ISIC level

ISIC Level	Speed of Price Adjustment		Average *HHI*
	When costs go down	When costs go up	
1511-Animal Slaughtering and Meat Processing	0.076	0.102	0.271
1512-Processing/Preserving of Fish	0.151	0.140	0.156
1513-Processing/Preserving of Fruit and Vegetables	0.032	0.401	0.446
1514-Animal and Vegetables Oils and Fats	0.180	0.211	0.472
1521-Dairy Products	0.245	0.336	0.423
1531-Grain Mill Products	0.146	0.284	0.282
1532-Starches and Starch Products	0.106	0.303	0.242
1533-Prepared Animal Feeds	0.196	0.316	0.100
1541-Bakery Products	0.141	0.319	0.048
1542-Sugar Processing	0.071	0.316	0.290
1543-Chocolate and Sugar Confectionery	0.049	0.111	0.240
1544-Macaroni, Noodles, Couscous, and Similar Farinaceous Products	0.052	0.050	0.068
1549-Other Food Products N.E.C.	0.181	0.272	0.120
1550-Distilling, rectifying and blending of spirits; ethyl alcohol production from fermented materials; Wines; malt liquors and malt	0.113	0.059	0.377
1554- Soft drinks; Production of mineral waters	0.461	0.200	0.049

Source: Author's calculation

Also, Table 4.4 shows that subsectors that produce non-storable goods and have the possibility of differentiating their products ("dairy products" and "processing/preserving of fruit and vegetables"), tend to have a higher speed of price adjustment when the costs go up than down. The firms operating in subsectors where product differentiation is possible may have monopolistic power on the products which enables them to control the price over the cost so that they can maintain their high price-cost margin. Thus, the possibility of product differentiation could be a source of upward price flexibility. Also firms producing non-storable products may be forced to respond quickly to the cost increases implying a higher upward price flexibility. In conclusion, although there may be other factors affecting price flexibility in a highly concentrated industry, Table 4.4 shows that the flexibility of price in response to cost changes in the most concentrated industries behaves in the same way in all subsectors.

4.5 Conclusions and discussion

This paper investigates the relation between price rigidity and industrial concentration in the Indonesian food and beverages industry using a model in which the speed of price adjustment is based on a partial-adjustment mechanism and the Cournot model of pricing.

The results suggest that industrial concentration affects price flexibility positively in the food and beverages industry, mainly for the moderately and highly concentrated subsectors. Also the effect of industrial concentration is higher when the costs go up than when the costs go down. Furthermore, the speed of price adjustment is larger when average costs go up than when they go down in the more concentrated subsectors. In addition, the unconcentrated subsectors have the largest speed of price adjustment when costs go down and the highly concentrated subsectors have the largest speed of price adjustment when costs increase.

This research concludes that more concentrated subsectors are characterized by a higher downward price rigidity in response to a cost reduction and a higher upward price flexibility in response to a cost increase. Furthermore, although the Cournot model used in this research does not account for a possible collusion, output-based price setting through collusion may exist in sectors that are classified as moderately and highly concentrated. Finally, this research finds that the relationship between industrial concentration and price rigidity is more conclusive in the concentrated industries. Since in the competitive market, industrial concentration has no effect on the percentage price change and firms adjust more rapidly to a cost reduction as well as less rapidly to the cost increase compared to the concentrated subsectors, more competition between firms in the industry is expected to lead to the downward price flexibility.

Better information about the price flexibility in the industry may improve the effectiveness of the anti-inflation policy implemented by the Indonesian government and Central Bank of Indonesia. In cooperation with the Commission for the Supervision of Business Competition (KPPU), the Republic of Indonesia may also increase competition, break cartels and end anticompetitive practices.

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Chapter 5

Structure, Conduct, and Performance: Evidence from the Indonesian Food and Beverages Industry

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Abstract

This article employs the Structure-Conduct-Performance (SCP) paradigm to investigate the simultaneous relationship between industrial concentration, price rigidity, technical efficiency, and price-cost margin in the Indonesian food and beverages industry. This research extends the SCP framework by including price rigidity and technical efficiency as additional key variables. The results suggest that there is a simultaneous relationship between industrial concentration, price rigidity, technical efficiency and price-cost margin with a positive bi-directional relationship between industrial concentration and price-cost margin. These findings imply that an appropriate course of action for the regulator in this highly concentrated industry is to reduce industrial concentration in order to increase competition, reduce upward price flexibility, and increase technical efficiency in the long run.

Keywords: structure, conduct, and performance, food and beverages industry, panel data and simultaneous equations model, technical efficiency

5.1 Introduction

The Indonesian food and beverages sector contributes significantly to the country's GDP and employment, as well as the well-being of the local population. Since 2004, the output of this sector accounted for about 7% of the Indonesian GDP and about 23% of the total industrial manufacturing output. Indonesian households spent, on average, about 50% of their income on food and beverages products in the period 2005-2006. Given its importance to the country's economy, understanding the behaviour and performance of producers in the food and beverages sector is essential for stimulating growth and avoiding welfare losses. The oligopoly structure in this sector increases not only the price-cost margin, but also technical inefficiency (Setiawan *et al.*, 2012a, b). Furthermore, Setiawan *et al.* (2012c) showed that the price in the Indonesian food and beverages sector was more flexible in going up than going down. The conditions of technical inefficiency, oligopoly structure, high price-cost margins, and price rigidity lead to welfare losses for consumers, which have to be targeted by policy makers. The simultaneity of the relation between industrial concentration, price rigidity, technical efficiency, and price-cost margin is also important. A simultaneous relationship suggests that firms are actively pursuing strategies (see Schmalensee, 1982; Lipszynski and Wilson, 2001) and, as a consequence, the regulator faces a more complex policy design. The existence of a simultaneous relationship between industrial concentration and price-cost margin may induce the regulator to intervene in the market directly to reduce industrial concentration.

In the economics literature, the relationship between industrial concentration, price rigidity, technical efficiency, and price-cost margin has been frequently investigated using the Structure-Conduct-Performance (SCP) paradigm (Bain, 1951; Zellner, 1989; Kalirajan, 1993; Setiawan *et al.*, a, b, c). The original SCP paradigm postulates that there is a one-way relationship between the three fundamental concepts, running from structure to conduct to performance (see Mason, 1939, 1949; Bain, 1951, 1956). This single-direction-of-causality assumption has been challenged by many empirical studies (Clarke and Davies, 1982; Zellner, 1989; Kalirajan and Shand, 1992; Kalirajan, 1993). On the other hand, Lipczynski and Wilson (2001) presented a schematic representation of the SCP approach which includes the possibility of feedback from conduct and performance on structure. Additionally, although structure and conduct in an industry can affect performance, the variables measuring performance themselves can interact as well. For example, technical efficiency is an important factor determining the price-cost margin (see Kalirajan and Shand, 1992) that could interact with another variable in the SCP paradigm, i.e. industrial concentration (see Setiawan, 2012b).

Although the relationship between industrial concentration, price rigidity, technical efficiency and price-cost margin in the SCP paradigm has for long been investigated in single and simultaneous equations models, the mutual relationship among all variables has not been considered. Kalirajan and Shand (1992) investigated the causality between technical efficiency and price-cost margin. Also Kalirajan (1993) concluded that there was a bi-directional relationship between industrial concentration and price-cost margin. Setiawan *et al.* (2012a, b, c) accounted for the problem of simultaneity, but only investigated the partial effect of industrial concentration on price-cost margin, technical efficiency, and price rigidity in the Indonesian food and beverages industry. From an econometric point of view, ignoring the problem of simultaneity could lead to false statistical inferences. Thus, studying the relationship among all variables in one simultaneous system of equations is important for empirical and policy reasons.

The aim of this paper is to measure industrial concentration, price rigidity, technical efficiency and price-cost margin and to empirically investigate the simultaneous relationship among these variables in the Indonesian food and beverages industry. This research contributes to the literature on the SCP framework by including technical efficiency as a performance variable into the system of equations, and by including price rigidity as an indicator of conduct. The analysis is performed within the SCP paradigm where feedback from conduct and performance on structure is not excluded *a priori*.

The remainder of this paper is organized as follows. Section 2 provides the conceptual framework of the relationship between industrial concentration, price rigidity, technical efficiency and industrial concentration. This is followed by the modeling approach in section 3 and a description of the data in section 4. The results are presented and discussed in section 5. The last section presents conclusions and policy implications.

5.2 The relationship between industrial concentration, price rigidity, technical efficiency, and price-cost margin

This section presents a theoretical underpinning, as well as a review of empirical findings for the relationship between industrial concentration, price rigidity, technical efficiency and price-cost margin.

5.2.1 Determinants of technical efficiency

Technical efficiency (*TE*) refers to the ability of a decision-making unit (usually a firm) to minimize input used in the production of a given bundle of outputs, or the ability to obtain maximum output from a given bundle of inputs (Kumbhakar and Lovell, 2003). Besides the amount of inputs affecting technical efficiency, which are by definition embedded in the technical efficiency score, external factors such as industrial concentration can influence the allocation of resources and technical efficiency. The quiet-life hypothesis argues that there is no pressure and no incentive for firms to increase their efficiency in a highly concentrated market. Gumbau-Albert and Maudos (2002) derived a model representing the relationship between technical efficiency and industrial concentration in the form:

$$Ln\left(\frac{TE}{1-TE}\right)=\alpha_j+\beta\cdot X_{jt}+\varepsilon_{jt} \qquad (1)$$

where *j* and *t* index subsector and period, respectively, *TE* is technical efficiency, and *X* are explanatory variables, including industrial concentration (*IC*).

Gumbau-Albert and Maudos (2002) found evidence in support of the quiet-life hypothesis, i.e. industrial concentration had a negative impact on technical efficiency. Furthermore, Setiawan *et al.* (2012b) concluded that there was a one-way relationship between industrial concentration and technical efficiency, with only industrial concentration affecting technical efficiency negatively and not vice versa. Therefore, it is hypothesized that industrial concentration negatively affects technical efficiency.

5.2.2 Determinants of price-cost margin

Price-cost margin (*APCM*) represents the ability of firms in the industry to mark up the price over production cost. Mathematical derivations of the effect of industrial concentration on the price-cost margin are found in Saving (1970), Cowling and Waterson (1976), Fischer and Kamerschen (2003a, b), and Kamerschen *et al.* (2005). Cowling and Waterson (1976) derived the following linear relationship between industrial concentration and price-cost margin for profit maximizing firms[1]:

$$APCM = \theta \cdot HHI \qquad (2)$$

where *APCM* is price-cost margin measured by profit plus fixed cost divided by revenue and *HHI* is the Herfindahl-Hirschman index.

Zellner (1989), Kalirajan (1993), and Setiawan *et al.* (2012a) showed that industrial concentration had a positive effect on the price-cost margin. Since few firms in a concentrated industry can exert their market power to influence price or quantity, it is expected that industrial concentration increases the price-cost margin. Bauer (1990) and Kalirajan and Shand (1992, 1999) found that price-cost margin could be affected by technical efficiency supporting the efficient-structure hypothesis[2]. Furthermore, Kalirajan and Shand (1992) found that only technical efficiency affected price-cost margin, but not vice versa. Firms in an industry with high technical efficiency can minimize the use of their inputs or maximize their outputs. Therefore, it is hypothesized that high technical efficiency leads to higher price-cost margin.

[1] We simplify the writing of parameters from the original equation.

[2] Originally they used the profit ratio or the price-cost margin to measure allocative efficiency. As a rule-of-thumb, allocative efficiency can be achieved if the above-normal profit is zero (i.e. price-cost margin is zero) (see also Marsden, 2006; Volkerink *et al.*, 2007). The high price-cost margin leads to higher price for firms as well as in the industry, ceteris paribus, which then reduces consumption. The lower consumption would reduce the combined welfare of consumer and producer which turns into the lower degree of allocative efficiency.

This research also considers industry size (*Size*) and demand growth (*Growth*) as exogenous variables affecting the price-cost margin. In a competitive market with no entry barriers (procompetitive argument), industry size can affect the price-cost margin negatively because firms are forced to lower their markups and increase their output to cover fixed costs. Industry size may affect the price-cost margin positively in a less competitive market because entry is more restricted in such a market (see Epifani and Gancia, 2006). Furthermore, demand growth can affect price-cost margin positively through larger sales in the market.

5.2.3 Determinants of industrial concentration

Industrial concentration (*IC*) is a measure of uneven distribution of market shares of firms in an industry. In the SCP paradigm, industrial concentration is always connected to firm behavior (conduct) and industrial performance. The argument of the equilibrium condition for profit maximization may be one of the fundamental reasons why industrial concentration can be affected by price-cost margin, since both industrial concentration and price-cost margin can be influenced by the cost and demand conditions in the industry (see Clarke and Davies, 1982; Jacquemin *et al.*, 1980; and Kalirajan,1993). Using the previous derivation of Cowling and Waterson (1976), Clarke and Davies (1982) found an endogeneity problem in the linear approximation of (2), deriving price-cost margin and *HHI* equations. They suggested that estimating both price-cost margin and the Herfindahl-Hirschman index equations using ordinary least squares (OLS) produces an inconsistent estimator.

Kalirajan (1993) found a two-way relationship between industrial concentration and price-cost margin, where the price-cost margin affected industrial concentration positively. The increase of capacity as a result of the higher price-cost margin can result in a positive effect of price-cost margin on industrial concentration. Therefore, a high price-cost margin could affect industrial concentration, positively.

Furthermore, based on Zellner's model (1989) and Setiawan *et al.* (2012a), this research uses demand growth (*Growth*) and capital-output ratio (*COR*) as exogenous variables determining industrial concentration. Capital-output ratio is used in the model to represent capital intensity as in Bhattacharya (2002). In addition, industrial growth and capital-output ratio are hypothesized to have a positive and negative effect on industrial concentration, respectively. Moreover, following empirical evidence (Setiawan *et al.*, 2012b)[3], this paper assumes that technical efficiency does not affect industrial concentration.

5.2.4 Determinants of price rigidity

Price rigidity is defined as the condition where some prices adjust slowly in response to changes in per unit cost or changes in supply or demand[4]. We use price rigidity as an indicator of firm conduct, since we argue that price rigidity represents the policy and pricing objectives that characterize the conduct variable as in Lipczynski and Wilson (2001). Caucutt *et al.* (1999), Bedrossian and Moschos (1988), and Setiawan *et al.* (2012c) suggested that price rigidity could be affected by industrial concentration and cost. Higher industrial concentration is expected to result in lower upward price flexibility in case there is no collusive behaviour among the firms in the industry (see Sweezy, 1939). Otherwise, firms in a highly concentrated industry can exert market power by adjusting prices more slowly when costs decrease and more quickly when costs increase (see Setiawan *et al.*, 2012c). Setiawan *et al.* (2012c) derived a linear model to investigate the relationship between industrial

[3] Setiawan *et al.* (2012b) concluded that the efficient-structure hypothesis does not apply in the food and beverages industry.

[4] Specifically, price rigidity in kinked demand curve introduced by Sweezy (1939) is defined as the slow price adjustment with respect to the other competitors' strategy.

concentration and price flexibility (*PM*) from a combination of the Cournot oligopoly and partial adjustment models:

$$\frac{\Delta P_{jt}}{P_{j,t-1}} = \lambda\beta\left(\frac{Q_{jt}}{P_{j,t-1}} \cdot HHI_{jt}\right) + \lambda\left(\frac{\bar{c}_{jt} - P_{j,t-1}}{P_{j,t-1}}\right) \qquad (3)$$

where *j and t* index subsectors and year. Since $\beta = -\frac{\partial P_{jt}}{\partial Q_{jt}}$, $\beta\left(\frac{Q_{jt}}{P_{j,t-1}}\right)$ approximates the inverse of the elasticity of demand, $\frac{1}{\varepsilon_{Q,P}}$. They found that high industrial concentration increases the percentage price change.

The effect of the unit cost (*Ucost*) on price rigidity is hypothesized to be negative, meaning that higher unit cost leads to higher price flexibility. The change in unit cost can affect the production plan which also affects price. Industry size is included as a control variable to explain price rigidity and is expected to have a positive effect on price flexibility, since industry size may reflect the quantity demanded in the market (see also Kandil, 1996).

Summarizing the theoretical background, it is hypothesized that the mathematical relationship between industrial concentration, price rigidity, technical efficiency, and price-cost margin can be written in the following system of equations:

TE=f(IC) *(4)*

APCM=g(IC, TE, Size, Growth) *(5)*

IC=h(PCM, Growth, COR) *(6)*

PM=d(IC, Ucost, Size) *(7)*

where $\frac{\partial TE}{\partial IC} < 0$, $\frac{\partial APCM}{\partial IC} > 0$, $\frac{\partial APCM}{\partial TE} > 0$, $\frac{\partial APCM}{\partial Size} > 0$, $\frac{\partial PCM}{\partial Growth} > 0$, $\frac{\partial IC}{\partial APCM} > 0$, $\frac{\partial IC}{\partial Growth} > 0$, $\frac{\partial IC}{\partial COR} < 0$, $\frac{\partial PM}{\partial IC} > 0$, $\frac{\partial PM}{\partial \mathrm{Ucost}} > 0$, and $\frac{\partial PM}{\partial Size} > 0$.

5.3 Modelling approach

Based on the theoretical considerations and previous empirical findings presented in the previous section, equations (8)-(11) are proposed to reflect the simultaneous relationship between industrial concentration, price rigidity, technical efficiency, and price-cost margin linearizing the mathematical relationships in the system of equations (4)–(7):

$$TE_{jt} = \alpha_j + \beta_1 IC_{jt} + \varepsilon_{jt} \quad (8)$$

$$IC_{jt} = \rho_j + \lambda_1 APCM_{jt} + \lambda_2 Growth_{jt} + \lambda_3 COR_{jt} + \psi_{jt} \quad (9)$$

$$APCM_{jt} = \gamma_j + \theta_1 IC_{jt} + \theta_2 TE_{jt} + \theta_3 Size_{jt} + \theta_4 Growth_{jt} + v_{jt} \quad (10)$$

$$PM_{jt} = \mu_j + \delta_1 IC_{jt} + \delta_2 Ucost_{jt} + \delta_3 Size_{jt} + e_{jt} \quad (11)$$

where *j* and *t* indicate the subsector within industry and period, respectively; *PM* is price-change magnitude or price flexibility, *Ucost* is unit cost of production, *TE* is technical efficiency, *IC* is industrial concentration, *APCM* is price-cost margin, *Size* is industry size, *COR* is capital-output ratio, *Growth* is demand growth, and ε, ψ, v, and e are error terms that capture statistical noise. Based on the equations (8)-(11), the exogenous variables used in the system are *Size*, *Growth*, *COR*, and *Ucost*. Equations (8)-(11) are estimated using an appropriate method for systems of simultaneous equations with panel data. Since both *TE* and *IC* as expressed by the *CR4* are restricted in the unit interval, we take the logit transformation of *TE* and *CR4*[5].

This research uses two measures of industrial concentration *(IC)*: concentration for 4-firms (CR_4) and Herfindahl-Hirschman Index (*HHI*). *CR4* considers the collective share of the four largest firms in a subsector, while *HHI* considers the uneven distribution of market shares of all firms in a subsector. Both indicators of industrial concentration are based on the market share of the firms and calculated by the formulas as in Pepall *et al.* (2002 *p. 55-57*)

[5] The logit transformation maps *CR4* or *TE* from the unit interval to the real line by using the inverse of the logistic function, $\frac{1}{1+e^{-x}}$.

and Setiawan *et al.* (2012a, b, c)[6]. Both *CR4* and *HHI* have limitations, but they complement each other. *CR4* is commonly used to classify the market into some categories of oligopoly (see Shepherd, 1999), but it cannot capture the distribution of the market share for all firms in the market. However, *HHI* can capture the distribution of the a firm's market share in a market, but it is rather difficult to classify the oligopoly categories from the *HHI*. In spite of this, Besanko *et al.* (2004) gave a classification of market structure based on *HHI*. Furthermore, Liebenberg and Kamerschen (2008) also discusses the importance of using both *HHI* and concentration ratio. Hence, it is necessary to use both concentration measures to clearly depict the market structure in the industry.

Price rigidity is measured by the percentage price-change *(PM)*, rather than the absolute percentage price change used by Caucutt *et al.* (1999). The percentage price-change *(PM)* is formulated, as follows:

$$PM = Log(P_t/P_{t-1}) \qquad (12)$$

Using the percentage price change instead of absolute price change can reflect price rigidity in either upward or downward movements.

Firm technical efficiency is estimated by Data Envelopment Analysis (DEA) as described in Setiawan *et al.* (2012b). This research uses the output-oriented DEA model with variable returns to scale (VRS). We use output-oriented DEA to identify technical inefficiency as a proportional increase in output production, with input levels held fixed. This assumption can be relevant in Indonesian economy because small and medium firms find difficulties to access financial institutions in order to expand their business in most of the periods. Firm-specific efficiency scores are obtained by solving the mathematical programming problem as in Coelli *et al.* (2005 *p.180*):

[6] Considering stocks, this paper calculates industrial concentration based on sales data because sales seem to explain more about market share than output.

$$\begin{aligned} &\max_{\delta,\lambda}\ \delta, \\ &\text{st} \quad -\delta q_i + Q\lambda \geq 0, \\ &\qquad \mathrm{x_i} - X\lambda \geq 0, \\ &\qquad \mathrm{I1'}\lambda = 1 \\ &\qquad \lambda \geq 0, \end{aligned} \tag{13}$$

A variable returns to scale model is used here as the industry is characterized by many distortions, preventing firms from operating at an optimal scale. The output oriented efficiency scores assume values in the interval from 0 to 1. In order to reduce the serial correlation in the efficiency scores among firms, this research uses the bootstrap technique of Simar and Wilson (1998). As the final result, we provide the biased-corrected efficiency scores as accurate measure of efficiency, obtained using the bootstrap method:

$$\begin{aligned} \hat{\hat{\delta}}(x,y) &= \hat{\delta}(x,y) - \mathrm{bias}_B\left[\hat{\delta}(x,y)\right] \\ &= 2\hat{\delta}(x,y) - B^{-1}\sum_{b=1}^{B}\hat{\delta}_b^*(x,y) \end{aligned} \tag{14}$$

$\hat{\delta}(x,y)$ and $\hat{\hat{\delta}}(x,y)$ are the consecutive original and biased-corrected efficiency scores, and $\hat{\delta}_b^*(x,y)$ is the bootstrap estimate of the efficiency score in the b^{th} out of B bootstrap repetitions. Technical efficiency scores for each subsector are estimated using firm-level data by averaging the efficiency scores of all firms in the subsector. We calculate average technical efficiency for each subsector, because we can not relate technical efficiency and industrial concentration in the firm-level data.

Price-cost margin is a measure of industrial performance (see Khalilzadeh-Shirazi, 1974; Domowitz *et al.*, 1986; Prince and Thurik, 1992). The price-cost margin (*PCM*) is calculated according to the formula proposed by Domowitz *et al.*[7] (1986), Prince and Thurik (1992), and

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[7] This approach, which has also been used in Domowiz *et al.* (1988) has been challenged by Kamerschen and Park (1993a, b). In the same year, Domowitz *et al.* (1993) replied that they did not view the comment by Kamerschen and Park (1993a, b) as a substantive criticism of their (1988) paper and the issue remains open.

Setiawan *et al*. (2012a). This price-cost margin formula allows for changes in inventories where considering that changes in inventories are important in the calculation with regard to the fluctuation in the business cycle in the Indonesian economy from 1995-2006[8].

The system of equations (8) - (11) is estimated using system GMM with fixed-effects. The system GMM is applied to the simultaneous equations by using instrumental variables which should be valid in the system (see Cornwell *et al.*, 1992; Ahn and Schmidt, 1999). The instrumental variables used for the estimation are the same for all equations i.e. *Size*, *Growth*, *COR*, *Ucost*, and all dummies reflecting the subsectors. The same instrumental variables are used for all equations because some previous research used all the instrumental variables as the exogenous variables that can enter to the all above equations (see Khalilzadeh-Shirazi, 1978; Weiss, 1995; Zellner; 1989; Kalirajan, 1993). Also theoretically, all the instrumental variables can affect all the endogenous variables in our models. The validity of instruments i.e. orthogonality condition of all instruments with the error terms, is tested using the Hansen (1982) J-test. Since this research uses heterogenous subsectors and yearly data, to correct for the possibility of heteroscedasticity and autocorrelation problems, the heteroscedasticity and autocorrelation consistent (HAC) covariance matrix is used, using the Newey-West (1987) estimator with the Bartlett Kernel function.

5.4 Data

This research uses firm-level data (establishment) to estimate industrial concentration, price-cost margin, technical efficiency, price rigidity, and instrumental variables in each subsector of the food and beverages industry. The data are obtained from the Annual Manufacturing Survey provided by the Indonesian Bureau of Central Statistics (BPS). The dataset covers the

[8] $$\text{PCM} = \frac{\text{Value added - Cost of labor} + \Delta\text{Inventories}}{\text{Sales} + \Delta\text{Inventories}}$$

period 1995-2006 for which the data are tractable and comparable for all subsectors[9]. The technical efficiency estimation allows for using only 33 out of 59 subsectors of the food and beverages industry[10] classified into 5 (five) digits of the International Standard Industrial Classification (ISIC) level[11].

The DEA models used for estimating technical efficiency distinguish one output and three inputs, i.e. raw materials, labor and fixed capital such as buildings, machines and equipment. Output is defined as value of gross output produced per establishment every year and deflated by the Wholesale-Price Index (WPI) of food and beverages. Labor efficiency units are used as a proxy for labor use[12]. Raw materials are the total costs of domestic and imported raw materials (including other costs related to the production such as electricity and fuel cost) and are deflated by the WPI of raw materials for food and the official WPI for imported raw food, respectively, published by the BPS. We define fixed capital as fixed assets, deflated by the WPI of machinery (excluding electrical products), transport equipment, residential and non residential buildings.

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[9] In spite of this, some subsectors are not fully reported in 2006.

[10] This paper includes the subsectors with minimum observation of 30 to get the valid results of technical efficiency estimation. It results to 33 subsectors where 6 (six) of them are the combination of the subsectors with observation less than 30, but they are still in the same ISIC 4 digit and they have close production process. The 6 (six) new subsectors are derived by combining subsectors with insufficient observations in the following way: 15113 = 15111+15112 ; 15130 = 15131+…+15134+15139 ; 15210=15211+…+15213 ; 15319 = 15312 + 15314+…+15318 ; 15320 = 15321 + 15324+ 15329 ; 15420 = 15422+15423+15424+15429.

[11] Actual codes used are not the ISIC codes, but comparable, coming from Klasifikasi Baku Lapangan Usaha Indonesia (KBLI). Actually, there are 59 subsectors in the food and beverages industry classified into 5 digit of ISIC level, 55 of which are related to food processing, with the remaining to the beverages industry.

[12] We modify the formula for labor efficiency units used by Tybout and Westbrook (1995) by :

$$L = \text{Number of production worker} + \text{Number of other worker} * \left(\frac{\text{Salary of other worker}}{\text{Salary of production worker}}\right)$$

Price-change magnitude as a measure of price rigidity is calculated using the growth of (deflated) price index of the products in each sub sector of the food and beverages industry (base year 2000). The actual price is transformed into a price index in order to make the price-change magnitude comparable across subsectors producing different outputs. Total output for each subsector is defined as the value of output produced every year and deflated by the annual sectoral WPI of the food and beverages industry (base year 2000). Unit cost is the per unit variable cost for each subsector of the food and beverages industry, deflated by the consumer price index with base year 2000. The use of real (deflated) prices eliminates the effect of inflation, especially in the period of very high inflation during the economic crisis in 1997-1998. The actual unit cost is transformed into an index to make the index comparable across subsectors. Further details on the construction of the variables are provided in the appendix.

Table 5.1 Descriptive statistics of the variables from 1995-2006 across subsectors

Variable	Mean	Standard Deviation	Coefficient of Variation	Minimum	Maximum
Average Price-Cost Margin (*APCM*)	0.186	0.072	0.387	-0.516	0.419
CR4	0.483	0.227	0.470	0.076	0.991
HHI	1210.498	1220.988	1.090	43.399	7323.505
Percentage of Price change (*PM*)	7.244	30.176	4.166	-48.169	197.860
Unit Cost (*Ucost*)	99.667	23.288	0.234	60.661	176.679
Material (in million Rupiah)	185.259	1254.719	6.773	0.102	127257.103
Labor (Person Index)	171.845	1281.995	7.460	4.000	167086.381
Capital (in million Rupiah)	1901.208	65435.776	34.418	0.099	7321000
Output (in million Rupiah)	225.270	1372.521	6.093	2.113	74304.753
Capital-output Ratio (*COR*)	4.243	12.638	2.979	0.054	92.828
Growth of VA (*Growth*)	0.352	0.943	3.727	-0.863	6.466
Size (Ln of Value Added)	19.626	1.571	0.080	15.609	23.657

Source: authors' calculation

Table 5.1 shows that the average *CR4* over years and subsectors is 0.483, which classifies the food and beverages industry as an oligopoly (see Shepherd, 1999 about the classification). The average price-cost margin (*APCM*) is positive during the period of estimation with an average of 18.6%. Furthermore, the capital-output ratio (*COR*) and growth of demand measured by growth of value added (*Growth*) have high coefficients of variation (2.978 and 3.727, respectively). The coefficients of variation of the inputs (material, labor, and capital) and output variables among the subsectors of the food and beverages industry are also quite high. This suggests big differences in the size of the firms and technologies used between subsectors.

Table 5.2 Technical efficiency scores and industrial concentration

Period	Average Biased-Corrected Efficiency Score	*CR4*	*HHI*	Price-Change Magnitude	Price-Cost Margin	Number of Firms
1995-1997	0.552	0.449	1023.303	8.390	0.204	5495
1998-2000	0.567	0.538	1445.602	20.304	0.186	4850
2001-2003	0.539	0.472	1127.625	0.286	0.185	5299
2004-2006	0.543	0.471	1245.821	0.006	0.188	6308

Source: Author's calculation

Table 5.2 presents the calculated values of industrial concentration, price rigidity, technical efficiency, and price-cost margin. Table 5.2 shows that the average technical efficiency is around 55% during the period under investigation, which means that the firms in subsectors of the food and beverages industry on average exploit about 55% of their production potential. The *CR4* is in the range of 0.449-0.538, which classifies the industry as a persistent oligopoly. The percentage price-change is fluctuating during the period under investigation in the range of 0.006% - 20.304%, whereas price-cost margin is more stable, on average in the range of 18% - 20%. The high fluctuation of industrial concentration and price-change magnitude during the period 1998-2000 coincided with a major economic crisis in the Indonesian economy. Technical efficiency also increased during the period of economic crisis (1997-1998). Many firms left the industry in that period, suggesting that the more efficient firms remained, explaining the increase in technical efficiency.

From Table 5.2 it is also seen that the distribution of market shares, as captured by the *HHI*, changes over time during the period from 1995 to 2006. The average is 1210.498, and its volatility reflects the dynamics of competition among firms in the subsectors of the food and beverages industry.

5.5 Results

Table 5.3 presents the parameters estimates of equations (8)-(11), for two measures of industrial concentration: *CR4* and *HHI*.

Table 5.3 Parameter estimates on the relationship between price rigidity, technical efficiency, price-cost margin, and industrial concentration using system GMM

Independent Variable	Dependent Variable : *PM*		Dependent Variable : *TE*	
	Coefficients	Coefficients	Coefficients	Coefficients
Intercept	15.129	17.493	1.059***	1.334***
	(63.669)	(74.259)	(0.186)	(0.177)
CR4	19.446*		-0.788***	
	(10.387)		(0.236)	
HHI		22.709*		-0.925***
		(12.557)		(0.237)
UC	31.808***	30.957***		
	(7.323)	(8.139)		
Size	0.107	-0.729		
	(2.606)	(3.513)		

Table 5.3 *continued*

Independent Variable	**Dependent Variable : *APCM***		**Dependent Variable : *CR4***	**Dependent Variable : *HHI***
	Coefficients	**Coefficients**	**Coefficients**	**Coefficients**
Intercept	-0.119*	-0.144*	1.278	1.356
	(0.085)	(0.087)	(1.173)	(1.270)
CR4	0.045**			
	(0.020)			
HHI		0.060**		
		(0.024)		
BEFF	0.034*	0.039*		
	(0.019)	(0.020)		
SIZE	0.011***	0.009*		
	(0.004)	(0.004)		
APCM			9.599**	8.110*
			(4.215)	(4.575)
COR			0.010	0.001
			(0.045)	(0.003)
GROWTH	0.010**	0.005	-0.003	0.027
	(0.003)	(0.004)	(0.003)	(0.046)

Hansen-J statistic for the system with CR4 model = 0.104, *p-value (df=5)* = 0.990
Hansen-J statistic for the system with HHI model = 0.097, *p-value (df=5)* = 0.990

Notes: * denotes significance at the 10% level Standard errors in parentheses
** denotes significance at the 5% level
*** denotes significance at the 1% level

Source: Author's calculation

Table 5.3 provides the values of the Hansen (1982) J-statistic of the system to test the validity of all instruments. The results of the Hansen-J test suggest all instruments in the system are valid as their orthogonality is not rejected at the 1% critical level for both models using *CR4* and *HHI* measures of industrial concentration. The tests fail to reject the orthogonality condition between the error terms and all instruments in the system.

Results in Table 5.3 show that there is a simultaneous relationship between industrial concentration, price rigidity, technical efficiency and price-cost margin, with all SCP variables affecting each other significantly (at the maximum of 10 % critical level) in the system. Also, there is a two-way relationship between industrial concentration and price-cost margin where industrial concentration affects positively price-cost margin and price-cost margin affects positively industrial concentration. Industrial concentration has a positive and negative effect on the price-change magnitude and technical efficiency, respectively. Furthermore, technical efficiency affects the price-cost margin significantly where higher technical efficiency increases the price-cost margin. These results are in line with findings of Zellner (1989), Kalirajan and Shand (1992), Kalirajan (1993), Bhattacharya (2002), and Setiawan *et al.* (2012a, b, c).

Industrial concentration has a negative effect on technical efficiency with coefficients of -0.788 and -0.925 for the model with *CR4* and *HHI* measures and significance at 5% and 1% critical level, respectively. The coefficients indicate that industrial concentration increases technical inefficiency in the food and beverages sector. A one unit increase in the logit of *CR4* and in *HHI* decreases the logit of technical efficiency by -0.788 and by -0.925 units, respectively[13]. The marginal effect of the *CR4* is -0.008 suggesting that the increase of the *CR4* by 1 unit, decreases the technical efficiency by 0.008 units, *ceteris paribus*[14]. The result supports the quiet-life hypothesis which states that firms operating in the highly concentrated industry have no pressure to increase their technical efficiency.

Moreover, industrial concentration has a positive effect on the price-cost margin at the 5% critical level with coefficients of 0.045 and 0.060, respectively. A one unit increase in the logit of *CR4* and *HHI*, increases price-cost margin by 0.045 and 0.060 units, ceteris paribus.

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[13] Although the coefficient of logit *CR4* does not have a direct one-to-one interpretation with the change of percentage of price change (and later with the other variables in the other equations), the sign of the coefficient robustly indicate such relationship.

[14] This marginal effect of *CR4* $(\partial TE / \partial CR4)$ is simply derived from the original equation. Other marginal effects related to the other equations are derived in the same ways.

The marginal effect of the *CR4* variable are 0.002 indicating that the increase in the *CR4* by 1 unit, increases price-cost margin by 0.002 units, ceteris paribus. Technical efficiency has a positive effect on the price-cost margin at the 10% critical level (the marginal effect of technical efficiency is 0.001). Furthermore, Size has a positive effect on price-cost margin at the 1% and 10% critical levels for the model with *CR4* and *HHI*, respectively. In addition, Growth is significantly influencing the price-cost margin only in the model of HHI at the 5% critical level.

Price-cost margin has a significant positive effect on *CR4* and *HHI* with coefficients of 9.599 and 8.110 at the 1% critical level, respectively. A one unit increase in price-cost margin increases the logit of *CR4* and *HHI* by 9.599 and 8.110 units, respectively. The marginal effect of the price-cost margin is 0.024 suggesting that the increase in the price-cost margin by 1 unit, increases the *CR4* by 0.024 units, ceteris paribus. The results suggest that a higher price-cost margin enables firms to invest more on the capacity, thereby increasing the industrial concentration. Moreover, capital-output ratio and demand growth has no a significant effect on the industrial concentration (at the 10% critical level).

Industrial concentration has a positive effect on the percentage of price-change with coefficients of 0.150 and 1.103 for the logit of *CR4* and *HHI* at 10% critical level, respectively. The coefficients indicate that an increase of the logit of *CR4* and *HHI* by one unit, *ceteris paribus*, increases the percentage price-change by 0.150 and 1.103 units, respectively. The marginal effect of the CR4 are 0.779 indicating that the increase of CR4 by 1 unit, ceteris paribus, increases the percentage of price change by 0.779 units. The results are in line with the finding of Setiawan *et al.* (2012c) who concluded that higher industrial concentration leads to lower price rigidity in the food and beverages industry, especially when the cost goes up. In addition, unit cost has a significant effect on the price-change magnitude for the models with *CR4* and *HHI* measures (at the 1% critical level, respectively).

Furthermore, market size has no significant effect on the price-change magnitude in the *CR4* and *HHI* models.

5.6 Conclusions and policy implications

This paper employs the Structure-Conduct-Performance (SCP) paradigm to investigate the simultaneous relationship between industrial concentration, price rigidity, technical efficiency and price-cost margin. Compared to previous research, this paper extends the SCP framework by including price rigidity and technical efficiency in the system of equations.

The results indicate that there is a simultaneous relationship between industrial concentration, price rigidity, technical efficiency, and price-cost margin. Furthermore, the results show that there is a two-way relationship between industrial concentration and price-cost margin. The results in this paper suggest that the original SCP paradigm is inadequate, as this paradigm postulates only a one way relationship between the three fundamental concepts of structure, conduct, and performance. This also suggests that firms are responsive to changes in the market. A change in one variable in the system leads firms to alter their strategies, which in turn leads to changes in other variables within the system simultaneously.

The two-way relationship between industrial concentration and price-cost margin suggests persistence of high price-cost margin and high industrial concentration. High industrial concentration may lead to high price-cost margin and high price-cost margins increases concentration in the long run. Moreover, technical efficiency affects price-cost margin positively, since technical efficiency lowers the per unit cost of production. Also, it is found that higher industrial concentration leads to lower technical efficiency. This result is in line with the quiet life hypothesis as it indicates that there is no pressure for the firms in the highly concentrated industry to increase their efficiency. In addition, it is found that industrial concentration increases in price flexibility in the food and beverages industry. Previous research showed that upward price flexibility in the Indonesian food and beverages industry was higher than downward flexibility. Hence, higher industrial concentration is expected to increase upward price flexibility rather than downward flexibility.

The existence of a simultaneous relationship between industrial concentration, price rigidity, technical efficiency and price-cost margin has interesting policy implications. The results on the relationship between industrial concentration and price-cost margin suggest that the regulator should take direct action aimed at increasing competition in the highly concentrated industry. This is because high industrial concentration and high price-cost margin are persistent as a consequence of the positive bi-directional relationship between the two variables. This also can be a sign that the 1999 competition law in Indonesia had no significant impact on market conditions of the food and beverages industry (see also Setiawan *et al*, 2012a). The introduction of the 1999 competition law may not yet reduce the market power of firms in the food and beverages industry. An appropriate response for the regulator in this situation is to reduce industrial concentration by e.g. eliminating barriers to entry in the industry. This would increase competition, reduce market power of the firms and can lower the upward price flexibility. The higher competition in the industry is also expected to increase technical efficiency of the firms in the long run.

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Appendix: Description of variables

- *CR4* = Share of 4 (four) big firms in sales, formulated by :

  $CR4_j = \sum_{i=1}^{4} MS_i$ where $j = 1,2,\ldots, m$ indexes the subsector, $i = 1,2,\ldots n$ indexes firms within a subsector, and MS_i is the market share of firm *i* in its respective subsector.

- Herfindahl-Hirschman index = $HHI_j = \sum_{i=1}^{n} (MS_i)^2 * 10000$ [15]

- Price-change magnitude (*PM*) = $Log(P_t/P_{t-1})$ where P_t is an subsector's price index.

- Price-cost margin (*PCM*) = $\frac{\text{Value added - Cost of labor} + \Delta\text{Inventories}}{\text{Sales} + \Delta\text{Inventories}}$

  Where value added is calculated by sales minus intermediate inputs except labor cost, cost of labor is total wages (rupiah), inventory (rupiah), and sales (rupiah). Rupiah is an Indonesian unit of money.

- Capital-output ratio (*COR*) = $\frac{\text{Total asset (rupiah)}}{\text{Output (rupiah)}}$ where total asset and output are deflated by consumer price index.

- Demand growth (*Growth*) = $\frac{\text{Value added}_t - \text{Value added}_{t-1}}{\text{Value added}_{t-1}}$

- Industry size (*Size*) = ln(Value added) where value of value added is deflated by consumer price index.

- Unit cost (*Ucost*) = $\frac{\text{Total cost (rupiah)}}{\text{Output (rupiah)}}$ where total cost and output are deflated by consumer price index.

[15] Prior to estimation HHI was divided by 1000 to avoid reporting trailing zeros in the estimates associated with this variable.

Chapter 6

General Discussion

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6.1 Introduction

The food and beverages industry contributes significantly to the Indonesian economy. Besides its contribution to the GDP and employment absorption, more than half of the household income, on average, is spent on products of this sector. This industry is characterized by high industrial concentration and market distortions[1]. The Indonesian competition law introduced in 1999 aimed at lowering the industrial concentration and correcting market distortions. However, this law may not work very well because of ineffective law enforcement on anti-competitive behavior (see Pangestu *et al.*, 2002). Hence high industrial concentration in the food and beverages industry is persistent. High industrial concentration enables firms to control the price over the cost such that it is more flexible upwards in response to cost increases than downwards due to cost decreases. Thus, in a highly concentrated food and beverages market in Indonesia, few firms can gain a high price-cost margin. In addition, a low competitive pressure for the firms operating in the highly concentrated sectors may cause the firms to be technically inefficient.

The main objective of this thesis was to examine the market structure, price rigidity, and performance as well as their relationship in the Indonesian food and beverages industry. This research differs from previous studies in terms of the variables used and the theoretical underpinning. A better understanding of the relationship between the variables may help policy makers in targeting anti-competitive behaviour.

The remainder of this chapter is structured as follows. Section 6.2 discusses empirical issues in this thesis. Section 6.3 synthesizes results. Section 6.4 presents the policy and scientific implications of the results and section 6.5 presents the conclusions.

[1] Before the 1999 economic reform, few firms had exclusive monopolies to supply some food and beverages products.

6.2 Empirical issues

This thesis employs two theoretical concepts i.e. the structure-conduct-performance framework (SCP) and the new empirical industrial organization (NEIO) framework[2] as the basis for the empirical models. Chapters 2, 3, and 5 use the SCP framework to investigate the relationship between industrial concentration, price rigidity, technical efficiency, and price-cost margin. Regarding the investigation on how industrial concentration evolves, the absolute β-convergence model is applied in the SCP framework to examine the convergence of industrial concentration in Chapter 2. The two-concepts within the SCP framework i.e. quiet-life and efficient-structure hypotheses underpin the relationship between industrial concentration and technical efficiency in Chapter 3. The new empirical industrial organization (NEIO) framework is used to relate industrial concentration and price rigidity in Chapter 4.

The original Structure-Conduct-Performance framework (SCP) suggests that there is a causal-effect that runs from structure to conduct to performance. This research extends the original SCP framework by having: (1) the bi-directional relationship between variables in the SCP framework (Chapter 2, Chapter 3, and Chapter 5), (2) the technical efficiency as another measure of performance correlated with industrial concentration in the empirical SCP model (Chapter 3), (3) two hypotheses i.e. quiet-life and efficient-structure hypotheses that are applied within the SCP framework (Chapter 3), (4) the relationship between two indicators of performance: price-cost margin and technical efficiency (Chapter 5). With respect to the extension in point (1), Chapters 2, 3, and 5 take into account the endogeneity problem arising from the two-way causal-effect between industrial concentration and price-

[2] NEIO framework is defined clearly in Bresnahan (1989) which is very different from the SCP framework in terms of measuring conduct and performance that relies on the model estimation rather than using accounting data. The model is also derived from a rigorous theoretical background such as the utility theory, demand and supply and profit maximization.

cost margin in the SCP framework. Consequently, Chapters 2, 3, and 5 extend the assumption in the model of Bain (1951) which treated industrial concentration as an exogenous variable, by instrumenting industrial concentration. Although Chapter 2 does not explicitly analyze the effect of performance on conduct and structure, taking into account the problem of endogeneity indicates that industrial concentration is also affected by price-cost margin[3]. With respect to the extensions in points (1), (2), and (3), Chapter 3 uses technical efficiency as a measure of performance and tests the two-way causal-effect between industrial concentration and technical efficiency. The result is very relevant to support or reject the assumption in Chapter 2 on whether firms operating in the highly concentrated industry gain high price-cost margin through anti-competitive practices. Chapter 5 investigates the effect of technical efficiency on the price-cost margin to account for the extension under point (4). Also in line with the extension in point (1), Chapter 5 extends the models from Chapter 2 to Chapter 4 by investigating all variables representing the structure, conduct, and performance (SCP) framework simultaneously. In this chapter, industrial concentration and price-cost margin are hypothesized to have a two-way causal-effect in the system of equations[4].

Furthermore, Chapter 4 uses the NEIO framework, departing in this way from the SCP framework used in Chapters 2, 3, and 5. The model derived in this chapter is a new structural model to investigate the relationship between industrial concentration and price rigidity. The

[3] The aim of this chapter is just to verify whether industrial concentration affects price-cost margin, mainly comparing before and after the introduction of 1999 competition law. Further, Bain (1951) suggested that structure affects conduct (collusion) implicitly, and then affects performance. Bain argued that collusion (can be expressed or tacit) is embedded in the market structure with few firms operating in the highly concentrated industry resulting in high profitability.

[4] All variables representing the SCP framework are applied in Chapter 5 because all information about how the relationship between the variables takes place are now known from previous chapters. Furthermore, the objectives of the previous chapters are to examine the relationship between some variables based on previous research. Also investigating the relationship between the variables partially would bring a strong argument and robustness when each variable is correlated with other variables in a system of equations.

model has an advantage compared to the models from the SCP framework because it is firmly based on microeconomic theory. However, the main reason of using this NEIO framework is to estimate the parameter associated with the speed of price adjustment related to the market structure which could not be extracted from the SCP framework-based model. The Cournot model is combined with the partial adjustment model to get a new model, explaining the relationship between industrial concentration and price rigidity[5].

This research extends the econometric methods to investigate the relationship between industrial concentration, price rigidity, technical efficiency, and price-cost margin by applying an appropriate technique for the system of equations in Chapter 5 i.e. Generalized Method of Moments (system GMM). The system GMM is applied to get unbiased as well as consistent estimators. Besides solving the problem of contemporaneous residual correlation among the equations, the method also corrects the problem of heteroscedasticity and autocorrelation.

The data used in this research are panel data which is a combination of cross-section and time series data. Firms (establishments) are surveyed over the period 1995-2006 by the Indonesian Bureau of Central Statistics (BPS). The data from BPS have three strengths: (1) The data cover the firms in the industry established in all regions in Indonesia. (2) The data set is relatively accurate because it is based on a transparent scientific methodology. (3) The products in each subsector classified by BPS are relatively homogenous. However, there are also weaknesses in the data set. First, the data surveyed collected by BPS represent only medium and big manufacturing firms in the food and beverages industry and do not cover the small firms. In spite of this, the survey still represents the food and beverages industry because according to Hill (1990), in the aggregate, the exclusion of small firms is not a

[5] Although the Cournot oligopoly model implies that firms use output as the strategy, this would not affect the argument of firms affecting the price rigidity in the highly concentrated industry, since the firms can control the price through the output setting

serious problem because small firms contribute no more than 15% of total manufacturing value added in 1985. Furthermore, the small firms contribute only 4.01% to non-oil export in 2006. The small firms only serve the local market rather than the national market. Second, BPS reports firm data based on establishment. This may underestimate industrial concentration, but the trend is still the same (Bird, 1999). Third, the assumption of uniform price in the Indonesian food and beverages industry may be problematic given the geographic diversity and size of the country. In spite of this, the firms and the population in Indonesia are concentrated in Java island and prices are relatively homogeneous across the provinces in Java island[6]. Also since the BPS reports firm data based on establishment, the uniform price is still possible because firms may have branches in other regions using the homogeneous input and transportation costs as in the Java islands. Finally, the data set from BPS has limitations in the variables provided. For example, the data set does not provide a variable that measures a conduct variable such as advertising expense. Also, the data set provides only one output for firms in each subsector implying that the technical efficiency calculation uses one output, instead of multiple outputs.

6.3 Synthesis of results

The results of the thesis are summarized in Figure 6.1 and Table 6.1. Figure 6.1 shows the relationship between industrial concentration, price rigidity, technical efficiency, and price-cost margin based on the results of all chapters. Figure 6.1 shows that industrial concentration affects significantly price rigidity, technical efficiency, and price-cost margin. Also industrial concentration and price-cost margin have a bi-directional relationship. Furthermore, exogenous variables (i.e. unit cost, capital-output ratio, industry size, and growth of demand)

[6] Total population of Java island is almost 60% of the total Indonesian population and 82.54% of total medium and big firms are located in Java island.

affect the relationship between industrial concentration, price rigidity, technical efficiency, and price-cost margin.

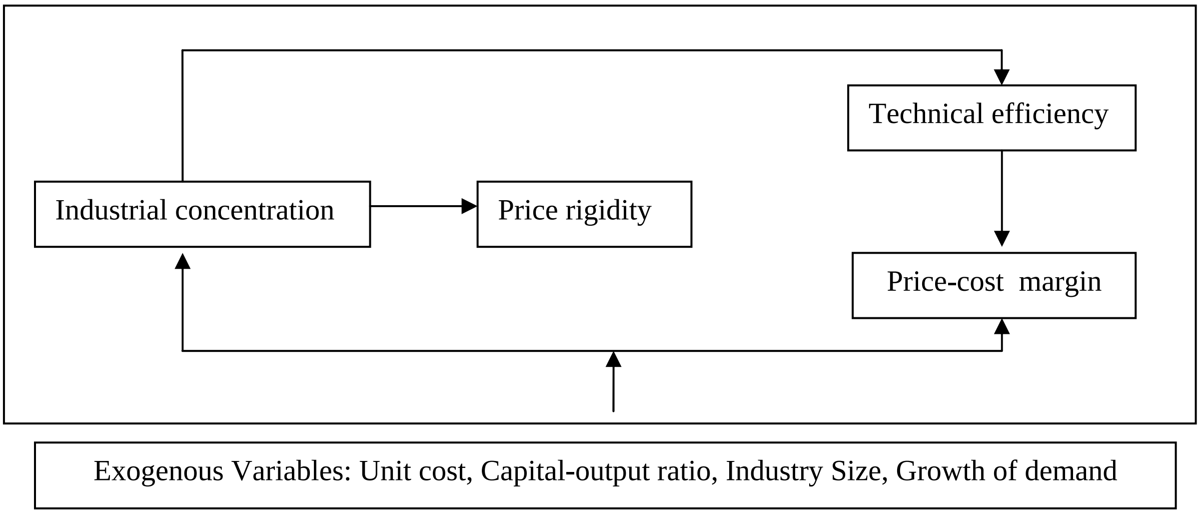

Figure 6.1The relationship between industrial concentration, price rigidity, technical efficiency, and price-cost margin

Table 6.1 summarizes the relationship between the variables in more detail based on results from all chapters. Chapters 2 and 5 find that industrial concentration affects price-cost margin positively. The estimation results are the same for the single equation (Chapter 2) and the system of equations (Chapter 5) suggesting this result is robust. Furthermore, Chapters 3 and 5 as well as Chapters 4 and 5 find similar outcomes for the relationship between industrial concentration, technical efficiency and price-cost margin. Furthermore, industrial concentration has a negative and positive effect on technical efficiency price-cost margin, respectively. In addition, Chapter 5 finds that technical efficiency affects price-cost margin positively and price-cost margin has a positive effect on industrial concentration. Also there is a two-way relationship between industrial concentration and price-cost margin.

Table 6.1 The direction of the relationship between industrial concentration, price rigidity, technical efficiency, and price-cost margin.

Dependent Var. / Independent Var.	Industrial concentration	Price-cost margin	Technical efficiency	Price rigidity
Industrial concentration	-	(+) (Ch. 2 & 5)	(-) (Ch. 3 and 5)	(+) (Ch. 4 & 5)
Price rigidity	-	-	-	-
Technical efficiency	-	(+) (Ch. 5)	-	-
Price-cost margin	(+) (Ch. 5)	-	-	-

Chapters 2 and 5 show that there is a positive effect of industrial concentration on the price-cost margin, but the effect of industrial concentration on the price-cost margin is reduced by the introduction of the 1999 competition law as found in Chapter 2. Furthermore, Chapter 2 finds that the law stopped the positive trend of the price-cost margin in the industry. However, in 2006 the industry still has high industrial concentration and price-cost margin.

Moreover, Chapters 3 and 5 suggested that the food and beverages industry is technically inefficient and industrial concentration could increase technical inefficiency in this industry. From these results, it can be concluded that high industrial concentration may cause the few firms to be technically inefficient. Having market power, the few firms in the industry could maintain a high price-cost margin through their ability to control the price as well as the output. Furthermore, the 1999 competition law had no significant impact on industrial concentration and price-cost margin. As explained in the previous paragraph, the law may break the anti-competitive practices by stopping the positive trend of price-cost margin as well as decreasing the effect of high industrial concentration on the price-cost margin, but the law may not yet influence market power as well as the behaviour of firms in allocating the resources (see Chapter 2).

Furthermore, Chapters 4 and 5 found that the food and beverages industry and especially the concentrated subsectors may contribute to higher prices in the industry. Subsectors operating in the concentrated industry have a higher speed of price adjustment when costs go up than when costs go down compared to the unconcentrated subsectors. Furthermore, the unconcentrated subsectors have a higher speed of price adjustment when costs go down than the concentrated subsectors. These results are in line with the conclusion of Chapter 2 suggesting that the few firms in the highly concentrated industry have market power to maintain the high price-cost margin.

Finally, Chapter 5 found that there is a simultaneous relationship between industrial concentration, price rigidity, technical efficiency, and price-cost margin. The relationships found between the variables are in line with those found in the previous chapters. Furthermore, the positive bi-directional relationship between industrial concentration and price-cost margin can be one of the reasons why high industrial concentration and price-cost margin are persistent in the Indonesian food and beverages industry. The high industrial concentration causes high price-cost margin and the few firms with high price-cost margin can invest heavily in the capacity and other beneficial market aspects that allow them to maintain or increase their market share. Maintaining their market share allows the firm to exercise market power to keep the desired price-cost margin by setting the upward price flexibility in the industry.

6.4 Implications of the results

6.4.1 Policy implications

The finding of Chapters 2 and 5 suggest that industrial concentration has a positive effect on the price-cost margin. Furthermore, Chapter 2 finds that the 1999 competition law reduces the effect of industrial concentration on the price-cost margin. Also, it stops the positive trend of the price-cost margin in the industry. However, the law did not reduce significantly the high industrial concentration and price-cost margin. Therefore, additional policy measures are needed to reduce market power by increasing competition as well as reducing industrial concentration in the long run.

The results of Chapters 3 and 5 suggested that the food and beverages industry is technically inefficient and industrial concentration has a negative effect on technical efficiency. From these results it is obvious that the high price-cost margin in the food and beverages industry as found in Chapter 2 is gained through anti-competitive practices rather than from higher technical efficiency. This suggests that policy makers should limit the firms to grow in size and support new entrants to the industry. Breaking the possibility of anti-competitive practices is also a main concern of policy makers, and could reduce industrial concentration in the long run.

Chapters 4 and 5 found that the high industrial concentration increases price flexibility, especially when the costs go up rather than when the costs go down. It indicates that the highly concentrated subsectors contribute more to inflation than unconcentrated subsectors. Regarding that, the government should focus on the highly concentrated subsectors in order to target inflation.

Furthermore, Chapter 5 found a positive bi-directional relationship between industrial concentration and price-cost margin suggesting a persistent high industrial concentration and high price-cost margin in the industry. An appropriate policy implication in this regard is to increase competition and reduce industrial concentration, so that it lowers the price-cost margin, which in turn, decreases industrial concentration continually in the long run.

The policy maker may limit the size of firms, increase competition and decrease industrial concentration through the following mechanisms. First, the government can eliminate all barriers to entry in the industry by opening access to all resources for all firms such as production and financial input and by eliminating regulations that give advantages to a few large firms. Economic distortions before 1999 caused few large firms to have exclusive monopolies on certain food and beverages. The monopoly power of these firms may still be observed nowadays. Second, the government should limit firms to increase size and market share, e.q. rejecting merger of big firms. This is also suggested by the findings of Chapter 4 indicating that few firms in the highly concentrated industry tend to be inefficient. Third, the government should revise the competition law for a better interpretation and strict law enforcement. Pangestu *et al.* (2002) found ambiguities that are still subject to interpretation in the Indonesian competition law, which may make the investigation and the law enforcement on anti-competitive behavior ineffective. A strict law enforcement is needed to penalize anticompetitive practices such as cartels or trusts. The Commission for the Supervision of Business Competition (KPPU), the body responsible for enforcing the law in Indonesia, should be provided with strong instruments to find and break the anticompetitive practices.

6.4.2 Scientific implications

Society is concerned about welfare losses (dead-weight losses) that are caused by price rigidity, low technical efficiency, and high price-cost margin in the highly concentrated food and beverages industry. Therefore, research on these variables in the Indonesian food and beverages industry is relevant nowadays and in the future.

This thesis provides methods that can be replicable in future research in other sectors of the Indonesian economy or in other countries. However, there are some issues that may be useful to be taken into account for future research related to the relationship between industrial concentration, price rigidity, technical efficiency, and price-cost margin:

1. Other methods can be applied to investigate the relationship between industrial concentration, price rigidity, technical efficiency, and price-cost margin. For example, a stochastic frontier approach (SFA) can be used to calculate technical efficiency. The SFA method can be compared to the DEA used in this research to see whether the results of the DEA method are robust. Other regression techniques such as tobit or truncated regression can be alternatives for estimating models with truncated variables.
2. This research uses the data survey from the Indonesian Bureau of Central Statistics (BPS) which have limitations in terms of the available variables. Using better data than the BPS would give richer models and analyses. For example, data that can provide price and quantity would support an analysis of welfare losses. With better variable availability, advanced structural models in NEIO such as methods from Azzam (1997) and Berry-Levinsohn-Pakes (1995) models can be applied to measure and investigate the relationship between technical efficiency, industrial concentration, price rigidity, and price-cost margin in a system of equations, without having a separate technical efficiency estimation using DEA or SFA techniques.
3. This research derives a model from NEIO framework only to investigate the relationship between the industrial concentration and price rigidity. Therefore, the possibility of using other NEIO frameworks to derive a model relating the variables in the SCP framework can be promising future research.

4. Since the parameters' robustness of the models is only tested using the existing data, an extended data period can be applied to test the robustness of the parameters to changes in the Indonesian food and beverages industry.

6.5 Main conclusions

The main objective of this research is to examine the market structure, price rigidity, and performance as well as their relationships for the Indonesian food and beverages industry. We arrive at the following main conclusions:

- Industrial concentration converges towards the same value for all subsectors in the food and beverages industry.
- Industrial concentration increases price-cost margin; the effect of industrial concentration is reduced by the introduction of the 1999 competition law.
- The positive trend of price-cost margin stopped after the introduction of the 1999 competition law indicating the effectiveness of the law in breaking the anticompetitive practices.
- There is only a one-way causal impact of industrial concentration on technical efficiency, i.e. industrial concentration reduces technical efficiency.
- Subsectors with higher industrial concentration have higher upward price flexibility.
- The concentrated subsectors have a higher (lower) speed of price adjustment when the cost goes up (down) than the unconcentrated subsectors.
- There is a simultaneous relationship between industrial concentration, price rigidity, technical efficiency, and price-cost margin.
- There is a positive bi-directional relationship between industrial concentration and price-cost margin.

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Summary

The Indonesian food and beverages industry has a share in the Indonesian gross domestic product of about 7% and provided employment for about 230 million people in 2006. However, the food and beverages industry is characterized by high industrial concentration, which increases the welfare losses for the economy as a whole. A few firms in the highly concentrated industry have market power which enables them to sustain the high price-cost margin by controlling the price. The main objective of this research is to examine the market structure, price rigidity, and performance as well as their relationships in the specific context of the Indonesian food and beverages industry. The main objective is divided into four research questions: (1) Does industrial concentration converge across subsectors of the food and beverages industry and what is the relationship between industrial concentration and price-cost margin after the introduction of the competition law in 1999? (2) Does industrial concentration have a causal impact on technical efficiency or is there a two-way causal relationship between these variables? (3) Does high industrial concentration limit price movements, especially when production cost decreases? (4) How are industrial concentration, price rigidity, technical efficiency, and price-cost margin related when examined in a system?

This research uses firm-level (establishment) data of 59 subsectors of the food and beverages industry sourced from the manufacturing survey of Bureau of Central Statistics (BPS) during the period from 1995 to 2006. In order to break anti-competitive practices and reduce high price-cost margins in the food and beverages industry, the Indonesian government introduced the 1999 competition law. Chapter 2 investigates the trend in industrial concentration as well as the effect of industrial concentration and the 1999 competition law on the price-cost margin. Empirical results show that industrial concentration converges to the same value for all subsectors. This suggests that highly concentrated subsectors are expected to become less concentrated in the long run, while the opposite is true

for subsectors that are currently characterized by relatively low concentration. Although the industrial concentration of the subsectors in the food and beverages sector tends to be slightly lower in the long run, the subsectors of the industry are still classified as tight oligopolies structure in the period covered by the data. Finally, as expected, industrial concentration is found to have a positive effect on the price-cost margin. The results suggest that the current policy design still does not reduce significantly the high industrial concentration and price-cost margin.

Chapter 3 calculates technical efficiency in the food and beverages industry and investigates its relationship with industrial concentration. The results show that the Indonesian food and beverages industry is technically inefficient. Another important result suggests that there is only a one-way relationship between industrial concentration and technical efficiency: having higher industrial concentration reduces technical efficiency. This indicates that the quiet-life hypothesis rather than the efficient-structure hypothesis applies in the Indonesian food and beverages industry. This result suggests a policy to limit the growth of firm scale that causes high industrial concentration in the industry.

Chapter 4 investigates the relationship between price rigidity and industrial concentration. The analysis develops an estimable model from the combination of a partial adjustment model and a Cournot model of oligopoly. The research assumes that firms indirectly control the price through an output-setting mechanism. The results show that there is a positive effect of industrial concentration on the percentage of price change, especially in the more concentrated subsectors. Higher industrial concentration increases the output price of the industry. Also there is a significant price adjustment in the food and beverages industry. Another finding suggests that there is a higher speed of price adjustment when costs go up for the concentrated subsectors than for the unconcentrated subsectors. Also the unconcentrated subsectors have a lower speed of price adjustment than the concentrated subsectors. These findings suggest that the high industrial concentration of the Indonesian food and beverages industry increases welfare losses.

The relationship between industrial concentration, price rigidity, and performance is investigated in a system of equations in Chapter 5. Using a system GMM estimation method, the results show that there is a simultaneous relationship between industrial concentration, price rigidity, technical efficiency, and price-cost margin. Also there is a positive bi-directional relationship between industrial concentration and price-cost margin. This suggests that there is a persistent high industrial concentration and price-cost margin, since high industrial concentration causes high price-cost margin and high price-cost margin simultaneously increases industrial concentration. From this result, it is also suggested that the policy maker should design a policy that makes all firms operate in a highly competitive environment and reduce industrial concentration. Furthermore, technical efficiency has a positive effect on price-cost margin and industrial concentration has a negative effect on technical efficiency, in line with the results from previous chapters. As found in Chapter 4, industrial concentration has a positive effect on price flexibility in the food and beverages industry.

Chapter 6 provides the main conclusions and discusses the main findings as well as their scientific and policy implications. The main conclusions of this thesis are summarized as follows:

- Industrial concentration converges towards the same value for all subsectors in the food and beverages industry.
- Industrial concentration increases price-cost margin; the effect of industrial concentration is reduced by the introduction of the 1999 competition law.

- The positive trend of price-cost margin stopped after the introduction of the 1999 competition law indicating the effectiveness of the law in breaking the anticompetitive practices.
- There is only a one-way causal impact of industrial concentration on technical efficiency, i.e. industrial concentration reduces technical efficiency.
- Subsectors with higher industrial concentration have higher upward price flexibility.
- The concentrated subsectors have a higher (lower) speed of price adjustment when the cost goes up (down) than the unconcentrated subsectors.
- There is a simultaneous relationship between industrial concentration, price rigidity, technical efficiency, and price-cost margin.
- There is a positive bi-directional relationship between industrial concentration and price-cost margin.

Samenvatting

De Indonesische voedingsmiddelen en drankenindustrie heeft een aandeel in het Bruto Binnenlands Product van 7% en verschafte werkgelegenheid aan 230 miljoen mensen in 2006. Deze industrie wordt echter gekenmerkt door een hoge graad van industriële concentratie, met negatieve economische gevolgen. Enkele bedrijven in deze industrie hebben marktmacht, die ze in staat stelt om een hoge prijs-kosten marge te handhaven. De hoofddoelstelling van dit proefschrift is om de marktstructuur, prijsrigiditeit en performance, alsook hun onderlinge samenhang te analyseren in de specifieke context van de Indonesische voedingsmiddelen en drankenindustrie. De hoofddoelstelling wordt opgedeeld in vier onderzoeksvragen: (1) Convergeert de mate van industriële concentratie over sub sectoren van de voedingsmiddelen en drankenindustrie en wat is de relatie tussen industriële concentratie en prijs-kosten marge na de introductie van de concurrentiewet in 1999? (2) Heeft industriële concentratie een causaal eenzijdig effect op de technische efficiëntie of is er sprake van een wederzijds effect tussen deze variabelen? (3) Beperkt een hogere industriële concentratie de prijsflexibiliteit, in het bijzonder wanneer de productiekosten afnemen? (4) Wat is de relatie tussen industriële concentratie, prijsrigiditeit, technische efficiëntie en prijs-kosten marge wanneer dit wordt geanalyseerd als een systeem?

Dit onderzoek gebruikt gegevens van bedrijven in 59 sub sectoren van de voedingsmiddelen en dranken industrie die zijn verzameld door het Centrale Bureau voor Statistiek (BPS) over de periode 1995-2006. Ten einde een eind te maken aan anti-concurrentie praktijken en om de prijs-kosten marges te verminderen in de voedingsmiddelen en dranken industrie, heeft de Indonesische overheid in 1999 de concurrentie wet geïntroduceerd. Hoofdstuk 2 onderzoekt de trend in industriële concentratie, alsook het effect van industriële concentratie en de concurrentie wet uit 1999 op de prijs-kosten marge. De empirische resultaten laten zien dat de industriële concentratie convergeert naar de zelfde

waarde voor alle sub sectoren. Dit suggereert dat de concentratie van de sterk geconcentreerde sub sectoren vermindert op de lange termijn, terwijl het tegenovergestelde geldt voor de sub sectoren met een lage concentratie. Hoewel de industriële concentratie van de sub sectoren van de voedingsmiddelen en dranken industrie naar lagere waarden tendeert op de lange termijn, kunnen de sub sectoren toch nog als oligopolie worden gekenschetst in de periode die wordt gedekt door de data. Tenslotte, zoals verwacht, heeft de industriële concentratie een positief effect op de prijs-kosten marge. De resultaten suggereren dat het huidige beleid de industriële concentratie en prijs-kosten marge nog altijd niet substantieel vermindert.

Hoofdstuk 3 berekent de technische efficiëntie in de voedingsmiddelen en dranken industrie en onderzoekt de relatie met de industriële concentratie. De resultaten laten zien dat voedingsmiddelen en dranken industrie technisch inefficiënt is. Verder laten de resultaten zien dat er en eenzijdig causaal verband is tussen industriële concentratie en technische efficiëntie: een hogere industriële concentratie vermindert de technische efficiëntie. Dit suggereert dat de ‘quiet-life’ hypothese in plaats van de ‘efficient-structure’ hypothese van toepassing is op de Indonesische voedingsmiddelen en dranken industrie. Overheidsbeleid moet er daarom op gericht zijn om de groei van bedrijven tegen te gaan.

Hoofdstuk 4 onderzoek het verband tussen prijsrigiditeit en industriële concentratie. De analyse in dit hoofdstuk is gebaseerd op een combinatie van een partial adjustment model en een Cournot Oligopolie model. Het onderzoek veronderstelt dat bedrijven indirect controle uitoefenen over de prijs door een prijsstellingsmechanisme. De resultaten laten zien dat industriële concentratie een positief effect heeft op de procentuele prijsverandering, vooral in de meer geconcentreerde sub sectoren. Een hogere industriële concentratie vergroot de output prijs in de markt waarbinnen de sector opereert. Er is ook sprake van een significante aanpassing van de prijs in de voedingsmiddelen en dranken industrie. De resultaten suggereren verder dat de meer geconcentreerde sub sectoren een hogere snelheid hebben waarmee prijzen zich aanpassen na een verhoging van de productiekosten dan de minder geconcentreerde sub sectoren. Deze resultaten suggereren dat een hogere industriële concentratie van de voedingsmiddelen en dranken industrie leidt tot welvaartsverliezen.

In Hoofdstuk 5 wordt het verband tussen industriële concentratie, prijsrigiditeit, en performance onderzocht in een systeem van vergelijkingen. De resultaten van de GMM schattingsmethode laten zien dat er een simultaan verband bestaat tussen industriële concentratie, prijsrigiditeit, technische efficiëntie en prijs-kosten marge. Er bestaat ook een positief en tweezijdig causaal verband tussen industriële concentratie en prijs-kosten marge. Dit suggereert dat de hoge industriële concentratie en prijs-kosten marge persistent zijn, aangezien hoge industriële concentratie bijdraagt aan een hoge prijs-kosten marge en een hoge prijs-kosten marge bijdraagt aan een hogere industriële concentratie. Deze resultaten suggereren dat de beleidsmakers beleid moeten ontwerpen dat leidt tot grotere concurrentie en lagere industriële concentratie. Technische efficiëntie heft een positief effect op de prijs-kosten marge en industriële concentratie heft een negatief effect op technische efficiëntie, in lijn met de resultaten uit de vorige hoofdstukken. Hoofdstuk 4 laat zien dat industriële concentratie een positief effect heft op de prijsflexibiliteit in de voedingsmiddelen en dranken industrie.

Hoofdstuk 6 geeft de belangrijkste conclusies en bespreekt de bevindingen en hun wetenschappelijke en beleidsmatige implicaties. De belangrijkste conclusies van dit proefschrift zijn:

- Industriële concentratie convergeert naar het zelfde niveau voor alle sub sectoren van de voedingsmiddelen en dranken industrie
- Industriële concentratie vergroot de prijs-kosten marge; het effect van industriële concentratie is echter verminderd na de introductie van de concurrentiewet in 1999.

- Na de introductie van de concurrentiewet in 1999 is de positieve trend in de prijs-kosten marge gestopt, wat suggereert dat de wet effectief is geweest in het beëindigen van de anti-concurrentie praktijken.
- Er is een eenzijdig causaal verband tussen industriële concentratie en technische efficiëntie: industriële concentratie vermindert technische efficiëntie.
- Sub sectoren met een hogere industriële concentratie hebben een hogere opwaartse prijsflexibiliteit.
- De meer geconcentreerde sub sectoren hebben een hogere (lagere) snelheid waarmee prijzen zich aanpassen aan kostenverhogingen (verlagingen) dan de minder geconcentreerde sub sectoren.
- Tussen industriële concentratie, prijsrigiditeit, technische efficiëntie en prijs-kosten marge bestaat een simultaan verband.
- Tussen industriële concentratie en prijs-kosten marge bestaat een positief tweezijdig causaal verband.

About the author

Maman Setiawan was Born on September 20, 1978 in Jakarta, Indonesia. In 2001, he finished his Bachelor Program in Economics with "Cum Laude" from University of Padjadjaran in Indonesia. He got his Master degree in Industrial Management from Bandung Institute of Technology, Indonesia with the Thesis related to Industrial Organization in 2004. In 2003, he was employed as a teaching assistant in Faculty of Economics and Business, University of Padjadjaran and he has been a permanent lecturer and researcher in the same Faculty since 2005. Later in 2009, he was admitted as PhD student in Business Economics, Wageningen University. During his PhD research, he followed his education program at the Wageningen School of Social Sciences (WASS), Netherlands of Network Economy (NAKE), and became a visiting scholar at Pennsylvania State University, USA. His PhD work has been presented in international workshops and seminars and published in peer reviewed journals.

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Name of the activity	Department/ Institute	Year	ECTS
Project related competences			
Advanced Microeconomics (ECH 32306)	WASS	2010	6
Advanced Macroeconomics (ENR 30806)	WASS	2009	6
Advanced Industrial Economics	NAKE	2010	3
Advanced Econometrics (AEP 50806)	WASS	2010	6
Organization of Agribusiness (BEC 31306)	WASS	2009	6
Economic Models (AEP 30806)	WASS	2010	6
Game Theory	NAKE	2010	3
Theory and Practice of Efficiency & Productivity Measurement: Static & Dynamic Analysis	WASS	2010	3
Theoretical Models and Empirical Measurement of The External Cost of Pesticides	WASS	2010	1.5
Institutional Analysis	Ronald Coase Institute, Moscow	2010	2
General research related competences			
Introduction course	WASS	2010	1.5
PhD Meeting	BEC-WASS	2009-2012	4
Academic Writing	Language Center	2010	2.4
Research Methodology	WASS	2010	6
Seminar: EWEPA 2012, ITALY	EWEPA	2011	1.5
Seminar: PhD Day 10 May 2012, Wageningen University	WASS	2012	1
Visiting Scholar at Pennsylvania State University	Penn State Univ.	2011	1.5
Career related competences/personal development			
Presentation Skill Workshop	Language Center	2010	1
Using voice in public presentation	BEC-WASS	2010	0.5
TOTAL			**61.9**

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