

MARKET STRUCTURE AND CONCENTRATION RATIO: EVIDENCE OF IT COMPANIES IN HUNGARY

JUDIT OLÁH, JÓZSEF POPP, DOMICIÁN MÁTÉ,
YUSMAR ARDHI HIDAYAT

ABSTRACT

The high numbers of Information Technology (IT) companies in Hungary may correlate with their market share. The number of existing companies may create a market structure and high levels of concentration. Therefore the purpose of this research is to analyse the market structure and concentration of IT companies in Hungary. Data used in this research is secondary data, and the tools of analysis used are the Hirschman-Herfindahl Index (HHI) and Concentration Ratio (CR). The results suggest that the type of market structure of IT companies in Hungary can be categorised as an oligopoly with low concentration. It follows that there is no leading company on the IT market. Here the findings indicate that telecommunication providers are deemed to be leaders in the IT industry in Hungary. In the oligopoly market, the strategy of a telecommunication provider would influence other competitors to set the price and differentiate their services. In addition, the government may stimulate the development of IT companies by imposing a differentiated tax.

KEY WORDS

Information technology companies, market structure, concentration ratio, and oligopoly.

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JUDIT OLÁH

e-mail: olah.judit@econ.unideb.hu
University of Debrecen,
Debrecen, Hungary

JÓZSEF POPP

e-mail: Popp.Jozsef@szie.gtk.hu
Szent István University,
Gödöllő, Hungary

DOMICIÁN MÁTÉ¹

e-mail: mate.domician@eng.unideb.hu

YUSMAR ARDHI HIDAYAT

e-mail: yusmar.hidayat@econ.unideb.hu
University of Debrecen,
Debrecen, Hungary

¹Corresponding author

Introduction

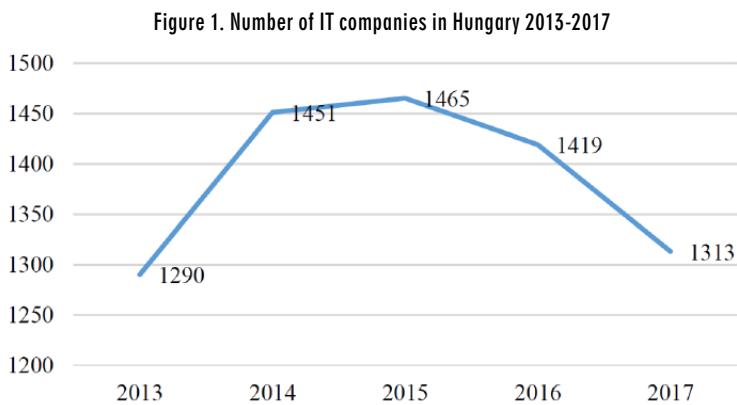
Information technology (IT) companies produce value-added products or services related to information technology, including computer hardware, software, electronics, semiconductors, internet, telecommunication equipment, and e-commerce (Jayawardane and De Alwis, 2017). IT companies use hardware, software, services, and supporting infrastructure to manage and deliver information using voice, data, and video (Žuřová et al., 2018). Based on the North American Industry Classification System (NAICS), the IT industry is classi-

fied within code 51 including Magazines, Books and Software (511); Publishing of periodicals, periodicals, books and directories (5111); Software publishing (5112); Film Production and Music Exhibitions (512); Broadcasting (excluding Internet) (515); Radio and Television Broadcasting (5151); Cable and other pay-TV services (5152); Telecommunications (517); Wired and wireless telecommunications (5173); Wired and wireless telecommunications (51731); Wired telecommunications (517311); Wireless telecommunications (excluding satel-

lite) (517312); Data processing, web-hosting (518); Other IT Services (519); Other IT Services (5191); and Online Media (51913) (EMIS, 2018a).

The Hungarian IT industry contributed 5% of the overall Gross Domestic Product in the last two years. The IT industry also had net revenues of approximately 8.7 million Euro in 2016, an increase of up to 0.9% year on year. The Hungarian IT sector is dominated by multinational companies in

the business areas of telecommunication, mobile phone, fixed-line, broadband internet, and pay-tv (EMIS, 2018a). Furthermore, the market has been concentrated on the influence of just a few companies. In line with the rapid growth of e-commerce, the IT industry has been growing rapidly for the last five years. The development of IT companies in Hungary over a five-year period is shown in Figure 1.



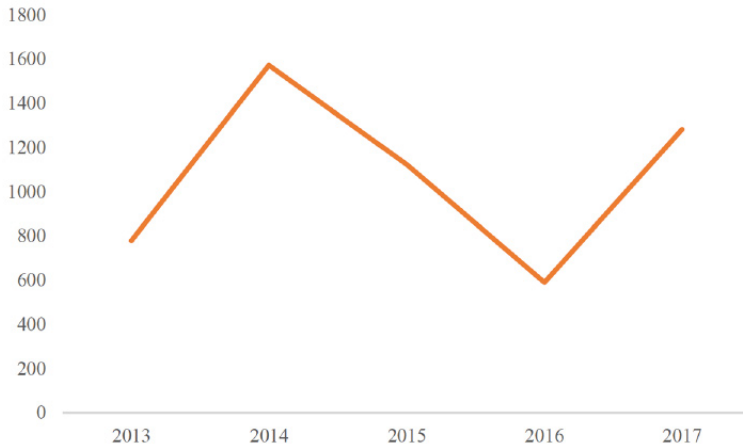
Source: EMIS, 2018b.

Many Information Technology (IT) companies sharply flourished in the three years since 2013, reaching a peak in 2015. However, the number rapidly decreased between 2015 and 2017. In general, there was a slight increase in the quantity of IT companies by approximately 2% for five years from 2013 until 2017. The number of IT companies in Hungary will probably steadily increase after 2017. This shows that IT companies face a fierce level of intense competition on the Hungarian IT market.

In spite of stiff competition, the Hungarian IT industry has a stable share of Hungary's economy, contributing between approximately 4.9% and 5.6% of Gross Value Added (GVA) between 2008 and 2015. This industry has also contributed positively to economic growth during the economic crisis period. The IT industry has

also encountered challenges in the forthcoming years in terms of the development of 5G services and Industry 4.0. Furthermore, government regulations have imposed special telecommunication and utility taxes on the IT industry. However, the government pressures the IT Industry to provide services at an economical price. In comparison to Central European countries in 2017, the GVA of the Hungarian IT sector reached about 1.2 billion Euro which was only one-third of Poland's GVA. The GVA of the Hungarian IT sector was lower than Austria, Romania, and the Czech Republic, which have GVA of more than 2.5 billion Euro (EMIS, 2018a; Androniceanu, 2019).

Profit-seeking is the main reason why IT companies enter the market. The profit fluctuation of IT companies from 2013 until 2017 is depicted in Figure 2.

Figure 2. Profit of IT companies in Hungary 2013-2017 (Million Euro)

Source: EMIS, 2018b.

Based on Figure 2, the beginning profit was about 0.8 million Euro, then profit doubled from 2013 to 2014. However, the profit decreased significantly between 2014 and 2016 to the lowest level of profit of about 0.6 million euro. The final profit recorded in 2017 was slightly higher at about 1.2 million Euro. In general, profit fluctuated but tended to increase slightly during the five years when this sector grew rapidly (Borocki et al., 2019). Based on the correlation between the number and profit of IT companies in Hungary, one may conclude in general that the slight increase in the number of IT companies in Hungary may result in a corresponding slight increase in company profit. There are many companies on the market, which may lead to tight competition. IT companies may compete with many competitors for profits. In addition, market concentration is correlated with the high or low level of their profits. Furthermore, the level of profits obtained by these companies indicates the level of company performance on the market (Gavurova et al., 2017). Hungarian IT companies may use their profits to support company performance and improve their ability to meet future challenges supporting Industry 4.0.

It is important to analyse the market structure and concentration in IT companies in Hungary because there are more than 1300 companies which are active on the market. The companies may try to obtain profit in a competitive market. The number of companies in the market determines how concentrated the market is. As a result, the market concentration may determine the number of market shares based on the profit acquired by IT companies (Oláh et al., 2018). A higher level of market concentration may result in lower revenues, while lower market concentration may increase the level of profits (Gavurova et al., 2017). Based on the aforementioned points, the purpose of this research is to investigate the market structure and concentration of IT companies in Hungary.

This research is based on a scientific background of market structure, concentration, and implication in the case of Hungarian IT companies. We apply the Herfindahl-Hirschman and Concentration Ratio to analyse the data. Subsequently, we deliberate certain empirical evidence of the links between government policy and market structure. Finally, we shall summarise some of the implications of the results for further research.

1. Literature review

Market structure is defined in terms of the market power of firms. Market power describes a situation in which a company has power over price. In the operational view, market power refers to monopolistic, oligopolistic or competitive power (Pandey, 2004; Sanusi et al., 2017). Market classification is based on the importance of individual firms in relation to the entire market in which they operate, and whether the products sold in a particular market are homogenous. From this taxonomy, there are four market types, namely pure competition, pure monopoly, oligopoly, and monopolistic competition (Meyer et al., 2017; Nguyen and Kira, 2014). The various types of market are described below.

1.1. Perfect competition

A significant factor is symmetric information on the market. Consumers have perfect information about the product or service offered by the company. IT companies offer homogenous products or services to customers (Ključnikov et al., 2019; Radu, 2018; Schüller et al., 2015). The companies may set the selling price of goods according to the price on the market determined by the interaction of supply and demand. They also can enter and/or exit the market freely. In the short run, the companies may make the most profit by making the marginal cost one and the same as marginal revenue and product price. Furthermore, in the long run, companies may obtain profit if price equals average cost.

1.2. Monopoly

The company may achieve monopoly power if they sell non-substitutive products or services. The monopolist may decide to set the price, the quantity of product supplied, and demand. The monopolist may consider adjusting the price by restricting sales volume to maximise the profit in the

short run. Next, the monopolist may set the marginal cost similar to marginal revenue in the long term. The monopoly market implies a negative effect on the market because the monopolist may impose a high price on customers.

1.3. Oligopoly

An oligopolistic industry is one in which only a few companies determine the change of output quantity and price, which may affect others. As a consequence, other companies will respond to an adjustment in price or output based on decisions made by one firm. In general, companies may offer different products or services on the oligopolistic market. The companies offer similar characteristics of products or services to customers by offering a lower price than market price to get a special market share. In connection with the above, IT companies may improve the quality of services offered to the customer in order to compete in the market.

The companies have the power to determine the demand, the price, and the output in the market. As a consequence, the firms could predict changes in price and output in the market by setting the supply curve either in part or as a whole. The companies may collude with others to an extent in order to have an impact on the pricing mechanism in the market (Plaček et al., 2016).

In the short run, companies determine the price and output as a form of collusion with other companies on the oligopoly market. This reflects the negative side of the oligopoly market. The companies are involved in a price war on the market. Subsequently, as industries mature, the relationship between the companies develops into a more collusive one. Consequently, the price may become rigid so that the companies may avoid a price war. Furthermore, the firms may take part in non-price competition, for instance advertisement

and product differentiation. In the long run, companies may modify the scale of the plant to determine the number of products as a positive impact of an oligopoly market (Mura et al., 2018). The companies may produce the quantity of output at the minimum average cost. As a consequence, newcomers may not enter the market. In addition, the current collusion may block new companies from entering the market in order to obtain long-run profits.

1.4. Monopolistic competition

Monopolistic competition consists of many suppliers which offer differentiated and substitutive products. Companies consider maximising the profit by setting the price and output when marginal cost is similar to marginal revenue in the short term. Furthermore, the market equilibrium may create a barrier to newcomers entering the market in the long term. Companies on the monopolistic market may obtain profit and set the price of the product at the intersection of marginal cost and marginal revenue. The potential profit, in the long run, may encourage newcomers (Kliestikova et al., 2019; Nguyen and Kira, 2014).

Rathinasamy et al. (2000) state that market structure (power) could be measured by the Lerner index, the Herfindahl-Hirschman index or Tobin's Q (Pandey, 2004). Market structure and market concentration correlates to profit and IT companies' behaviour in competing with other companies. Bain argued that fewer companies on the market may lead to less competitive behaviour and performance. The company would increase its performance based on the ability to achieve a higher level of income. There would be a positive relationship between concentration and performance (Gavurova et al., 2017; Meyer et al., 2016; Ślusarczyk and Kot, 2012; Valaskova et al., 2018). In addition, Rumler and Waschiczek (2016) also argued that the

higher level of concentration would reduce competition by encouraging collusive behaviour between firms; by contrast, lower concentration on the market may result in improved performance by discouraging collusive behaviour. Furthermore, a larger market concentration may lead to higher profits. Market concentration refers to the accumulation of market shares in a particular business. It concludes that the high level of market concentration determines that few companies may achieve a larger market share (Rahman et al., 2019). However, low market concentration implies that a large number of companies may maintain a lower level of market revenue (Belás et al., 2015; Cipovová and Belás, 2012; Kliestik et al., 2018). In addition, large multinational companies have dominated the Hungarian IT industry.

2. Method and data

The data used in this research is secondary data downloaded from the EMIS website. The data consists of the profits earned by IT companies in Hungary in 2017 and 2018. One equation which reveals market concentration is the Hirschman-Herfindahl Index (HHI) and the Concentration Ratio (CR) (Pandey, 2004; Rathinasamy et al., 2000).

$$HHI = \sum_{i=1}^n S_i^2 \dots\dots\dots (1)$$

where:

- HHI = Herfindahl-Hirschman Index
- S_i = Market share squared
- n = total companies in the market

The HHI ranges from $1/N$ to 1, where N is the number of companies in the market. Similarly, if percentages are used as whole numbers, the index can range up to 10,000. The meaning of the HHI can be shown in four categories, as follows:

- An HHI below 0.01 (or 100) indicates a highly competitive industry.

- An HHI below 0.15 (or 1500) indicates an un-concentrated industry.
- An HHI between 0.15 to 0.25 (or 1500 to 2500) indicates a moderate level of industry concentration.
- An HHI above 0.01 (or 2500) indicates a high concentration.

The equation for CR is shown in equation 2

$$CR = \sum_{i=1}^n r_i \dots\dots\dots (2)$$

where:

CR = Concentration Ratio

where:

r = market share industry i.....n

The concentration ratio (CR) is calculated as the sum of the market share percentage held by the largest specified number of firms in an industry (Gupta and Krishna-murti, 2016). The CR ranges from 0% to 100%, and an industry's concentration ratio indicates the degree of competition in the industry. The categories of CR are described below:

- No concentration, if the CR is close to 0% (which is only possible for quite a large number of firms in the industry); this indicates there is perfect competition, or at the very least monopolistic competition.
- Low concentration, if the CR ranges 0% to 40%; this indicates that the category of the industry ranges from perfect competition to an oligopoly.
- Medium concentration, if the CR ranges 40% to 70%; this indicates that the industry is categorised as an oligopoly.
- High concentration, if the CR ranges 70% to 100%; this indicates that the industrial category ranges from an oligopoly to a monopoly.

The concentration ratio is used to analyse the categories of the operating income of the IT companies, their market share, and concentration ratio. Descriptive

statistics are applied to analyse the mean, median, range, deviation, and group of the IT Industry.

3. Results and discussion

There are 1990 IT companies in Hungary, based on data downloaded from EMIS. Almost all the IT companies are located in Budapest, as shown in Table 1.

Table 1. Number and location of IT companies in Hungary

No.	City in Hungary	Number of IT Companies
1	Budapest	1437
2	Debrecen	35
3	Budaors	32
4	Szeged	20
5	Szekesfehervar	20
6	Pecs	19
7	Nyiregyhaza	19
8	Gyor	19
9	Erd	17
10	Miskolc	13
11	Kecskemet	13
12	Szentendre	10
13	Tatabanya	10
14	172 cities (with fewer than 10 companies).	326
Total		1990

Source: EMIS, 2018b.

The total IT number of IT companies recorded by EMIS is 1990, but the number of active IT companies is around 1330. Most IT companies are concentrated in the capital city and the rest are located in provincial cities, as shown in Table 1.

Many IT companies compete in the market for revenue. The figures for the total revenue obtained by IT companies in 2018 is given in Table 2.

Table 2. Descriptive statistics of the total revenue of IT companies in 2018

	Total Operating Income	Value in million Euro
	Mean	Statistic
	Std. Error	71.86
Range	Statistic	1970.01

Std. Deviation	Statistic	71.86
Variance	Statistic	5164.75
Skewness	Statistic	21.7
	Std. Error	0.077
Kurtosis	Statistic	563.06
	Std. Error	0.155

Source: EMIS, 2018b; n=1990.

The average total revenue of IT companies was approximately 10.5 million Euro in 2018, with a range of total incomes of about 1970 million Euro. This indicates that there may be a large range of total incomes among IT companies. Furthermore, the standard deviation is about 71.8 million Euro. The positive skewness value shows that the income distribution of IT companies is mostly below average. This shows that the majority of IT companies earn below-average income. In addition, kurtosis shows the homogeneity of data. The kurtosis with a positive value indicates that most IT companies generate similar income as other companies in the market. Most of the companies that earn below-average incomes are small and medium companies.

Based on their market share, the IT companies are classified into four groups. This classification indicates the different groups of IT companies operating in the market. The classification is shown in Table 3.

Table 3. Market share groups of IT companies

Group	Frequency	Percentage
Market share >20 per cent	1	.1
Market share 5-10 per cent	3	.3
Market share 1-5 per cent	30	3.0
Market share 0-1 per cent	966	96.6
Total	1000	100.0

Source: EMIS, 2018b; n = 1000.

A high percentage of IT companies have a market share of below one per cent. This implies that most IT Hungarian companies earn a low total operating income. Most of these companies are small and medium-sized enterprises. Next, the second group,

comprising only three per cent of the sample, are those companies with a market share of between one and five per cent. The remaining 0.3 per cent have a market share of between five and 10 per cent. Only one company has a market share above 20 per cent. This company is a telecommunications company, as are the companies with a market share of five to 10 per cent. The low market share indicates that most companies have low total revenues. In addition, IT companies face the possibility of losing profits because the government will levy ad hoc taxes and a utility tax (EMIS, 2018b). This dual taxation might not be an effective way to stimulate the development of IT companies. One policy which the Hungarian government might consider is to set a proportional tax on small and medium-sized companies. Instead, it is considered possible that the government could impose a proportional tax on small businesses. However, the government could levy a progressive tax on companies that have high profits with a market share of more than twenty per cent.

Based on the analysis of net revenues, the Herfindahl-Hirschman Index (HHI) is applied to analyse the market share and the concentration of shares on the IT market. The HHI represents the market share of IT companies. The results of the HHI analysis are depicted in Table 4.

Table 4. Herfindahl-Hirschman Index analysis of the top 10 IT companies in Hungary

No.	Top 10 Companies in the IT Market	Net Revenues (in million Euro)	Market Share (MS)	MS2
1	Magyar Telekom	1970.49	22.27%	495.7958
2	Magyar Posta	543.02	7.59%	57.54697
3	Telenor Hungary	539.91	5.66%	32.00331
4	Vodafone Hungary	505.93	5.04%	25.43958
5	UPC Hungary	316.54	4.81%	23.17658
6	Invitel	241.16	1.33%	1.769496
7	DIGI	229.95	1.58%	2.489432
8	Nemzetilfokommunikacios	190.85	1.57%	2.477786
9	NNG	159.47	1.10%	1.212487
10	SAP Hungary	153.77	1.01%	1.017583
Total		4851.09	HHI10	642.929

Source: EMIS, 2018a; n = 10.

Magyar Telekom has the highest net income with a market share value of about 22 per cent, whereas Magyar Posta has only one-third of the revenue of Magyar Telekom. Telenor Hungary and Vodafone Hungary have similar net revenues of around 500 million Euro with a similar market share of about 5%. UPC Hungary has a net revenue of about 300 million Euros, with a market share of under five per cent. The remaining companies with a market share of about one per cent are Invitel, DIGI, Nemzetilfokommunikacios, NNG, and SAP Hungary.

The market share of the top 10 IT companies shows that there is no single IT company which dominates the market in Hungary. This is shown by the value of the market share from the Herfindahl-Hirschman Index (HHI), which is about 643, i.e. below 1500. This means there are no companies which have a significant lead in the market. It also shows that there is a competitive marketplace among IT companies in Hungary. Furthermore, it also represents low market concentration or an un-concentrated market in the IT industry.

Table 5. Herfindahl-Hirschman Index cumulative

No	Company	Cumulative Frequency of Concentration Ratio
1	Magyar Telekom	22.27%
2	Magyar Posta	29.85%
3	Telenor Hungary	35.51%
4	Vodafone Hungary	40.55%
5	UPC Hungary	45.37%
6	Invitel	46.70%
7	DIGI	48.28%
8	Nemzetilfokommunikacios	49.85%
9	NNG	50.95%
10	SAP Hungary	51.96%

Source: EMIS, 2018a; n=10.

Based on Table 5, four IT companies account for 40% of the cumulative market share. These figures indicate an oligopoly market, which means that there is low concentration on the market, and no single dominant entity. Furthermore, IT companies have not been able to enter into formal collusion to determine the price of services for customers. This implies that most IT companies in Hungary may generate lower market revenue, as shown in Table 4 (Gavurova et al., 2017; Pandey, 2004).

Telecommunications companies dominated the list of the top 10 companies in the IT industry. This result may support the previous research conducted by Mahajan (2006) and Gavurova et al. (2017) with the

same condition that the mobile phone provider-type of company is categorised as an oligopoly market. The oligopolistic market for mobile phone providers in Hungary is dominated by telecommunications companies, which implies that if providers changed their output and prices it would affect other companies, and other firms would react to any price or output changes initiated by one company. Telecommunication providers in Hungary may offer differentiated services, but the services of each firm have similar characteristics. In addition, IT companies may be discouraged from entering into any collusion strategy with other similar companies (Gupta and Krishnamurti, 2016; Mahajan, 2006; Nguyen and Kira, 2014; Pandey, 2004).

Conclusions

Most IT companies operate in the capital city. The market type among IT companies in Hungary tends toward an oligopoly market with low concentration. As a consequence, the large number of IT companies can determine the share of total revenue, and this means that there are no dominant companies on the IT market. In addition, the highest revenues are generated by telecommunications service companies, which can be leaders on the IT industry market in Hungary. In an oligopoly market, the strategy of a telecommunications provider has an effect on other companies when it sets prices and differentiates its services. In line with any attempt to improve their services, IT companies can invest their profits in developing their businesses, supported by the government imposing a differentiated tax which is proportional for small or medium-sized companies, and a progressive tax for multinational companies. In the future, a novel direction for research will be to obtain a detailed picture of the relationship between the different factors which influence the

competitiveness of the Hungarian market, i.e. food, manufacturing and pharmaceutical industries (Lakner et al., 2019; Máté et al., 2017). This research could continue to examine the strategic planning and collusive behaviours adopted to survive in an oligopolistic market.

This study can contribute to an analysis of the market structure and the concentration of profit among IT companies. It also suggests that the Hungarian government should impose a proportional tax on small-medium IT companies, as they constitute the majority on the market. However, the government could levy a progressive tax on companies with a market share of above 20 per cent. This policy could be an effective approach to developing IT companies in Hungary. Small and medium-sized IT companies, which make up the majority of companies, could invest their profits in developing their performance in order to support Industry 4.0. This study could continue to investigate the strategy and collusion behaviours adopted by IT companies to survive on an oligopolistic market.

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- Prof. Dr. H.c. Popp, József** is a Corresponding Member of the Hungarian Academy of Sciences and university professor at Szent István University, Faculty of Economics and Social Sciences. He is a reviewer for several international journals. The scope of his current research interests encompasses international agricultural policy analysis, competitiveness, rural development, supply chain management and bioenergy. He is also an active member and chairman of several academic and professional organisations and regularly conducts professional training seminars for various organisations. He is also a member of the Editorial Advisory Board of *Amfiteatru Economic (Web of Science)* and guest editor of *Sustainability (Web of Science)*. <https://orcid.org/0000-0003-0848-4591>
- Judit Oláh, PhD, Habil.** is an Associate Professor of the University of Debrecen Faculty of Economics and Business Institute of Applied Informatics and Logistics, Hungary. Her research interests include logistics and supply chain management, operations management, transportation and warehouse management. Her research has appeared in several high-ranking national and international journals. She is also a member of the Editorial Advisory Board of *Amfiteatru Economic (Web of Science)* and guest editor of *Sustainability (Web of Science)*. <https://orcid.org/0000-0003-2247-1711>

Domicián Máté, PhD, Habil is an Associate Professor at the University of Debrecen, Institute of Industrial Process Management Department of Engineering Management and Entrepreneurship. Scientific interests include analysing the role of human capital, technology and institutions in the case of productivity, employment in a sectoral approach. <https://orcid.org/0000-0002-4995-7650>

Hidayat, Yusmar Ardhi is a PhD student at the University of Debrecen, Hungary. He is working towards a doctoral degree in Management and Business. His research interests include microeconomics and industry performance. <https://orcid.org/0000-0002-1835-6879>