"Pricing Game" for tacit collusion and Passive Investment

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Abstract. This paper aimed to figure out the structural factors of tacit collusion from the perspective of the oligopolistic market. A two-step approach is adopted to analyse this phenomenon. As pricing mechanisms shift from traditional method to computational algorithm, herein termed the "pricing game", new forms of collusion are expected to emerge. First, game theory is applied toward an understanding of this unspoken collusion, which involves interaction between different parties. A potential new form of collusion is identified as having been created by information signals in the price networks. Second, firms are owned by overlapping sets of investors (passive investors), and their incentives to compete are thereby reduced. Investors are rapidly shifting their investment allocations from active to passive management (ETF; Exchange Traded Funds), in response to the complexity of asset management and the excess liquidity from central banks around the industrial world. This trend has accelerated during the last decade. A potential solution for this situation may be found in family ownership, as a countervailing power for healthy competition.

Keywords: Tacit Collusion, Oligopoly, Pricing Algorithm, Game Theory, Passive and Active investor,

1 Introduction

"Googling", "Hotel and Flight Booking", and other modes of accessing information are now commonplace in our everyday lives. They have been described as "algorithms-as-institutions" (Robyn, et al., 2018). Raising questions about the extent to which human decision-making processes will ultimately be replaced, in certain cases, by machines (OECD, 2017). However, there are a growing number of companies using a computer algorithm for improving their pricing models, tailored services and predict market trends, not simply for customers but, particularly, to maximize profit. The pricing model is not only constructed by traditional supply and demand, but also using an ever faster, cheaper, and more powerful computer, which can fully automats to optimise a particular interaction between parties.

This study discusses a price which shows their product value, cost structure and their competitiveness. For example; Flight ticket prices are approximately 3% to 7%

higher in the American airline route than would be the case under special condition of ownership (Azar, et al., 2017). Also, many fees for banking services are recorded at historical highs in America despite offering the lowest interest rate in recent time (Jose, et al., 2016). For example, the price of eating or drinking at an amusement park or high prestigious restaurant is higher than downtown, of course, because the price is affected by location (i.e. a special condition). Galbraith, K. notes the dependence effect. Demand for goods and services is organic if the consumer suffers a privation. However, the new demands are created by advertisers who benefit from increased consumer spending and to provides a less urgent supply. The goal is to fight against those affirmations based on "conventional wisdom" (Galbraith, 2010), so-called "institution".

Generally, firms compete with one another by offering the best prices in a particular market. The "pricing game" can lead to cartels. *Industries using sophisticated computer algorithms can promptly calculate interactions with competitors and update their prices while also considering their next move* (Ezrachi , et al., 2015). This computer algorithm may represent a signal for the counterpart; however, it tends to remain undetected, most notably by antitrust authorities.

This research aimed to identify the structural factors of tacit collusion, which is when two firms agree to play to a particular condition without explicitly stating an exact price. For example, Company A holds more than 50% of the market share and sets the price at 100. There is then the question of how counterpart Company B should behave under the condition (Figs. 1 and 2). If Company A is a price leader, Company B usually follows it. Both companies depend on the action of their competitor, here Company B. When company B reduces the price to 80, it can gain market share. The normal reaction of company A would be to reduce its price to 80 also. The overall response is good for the consumer. However, there is a way to avoid reducing their price yet keep their profit; this is called "tacit collusion".

The price mechanism is shifting from the traditional method to a computational algorithm. New collisions can form via computational signals. Also, in general, shareholders are becoming decentralised and institutionalised. A shareholder's money is in trust with institutional investors who are interested only in high and stable dividends and dislike issues that could reduce these dividends. Furthermore, a money manager can create a smart investment approach, such as an exchange-traded fund (ETF). Holders of ETFs are shareholders who desire high and stable dividends but are not keen to be directly involved with company management. Galbraith suggests a countervailing power, which optimises stakeholders under certain conditions. Family ownership can provide such countervailing power because it imposes identity onto a company's culture and strategy.
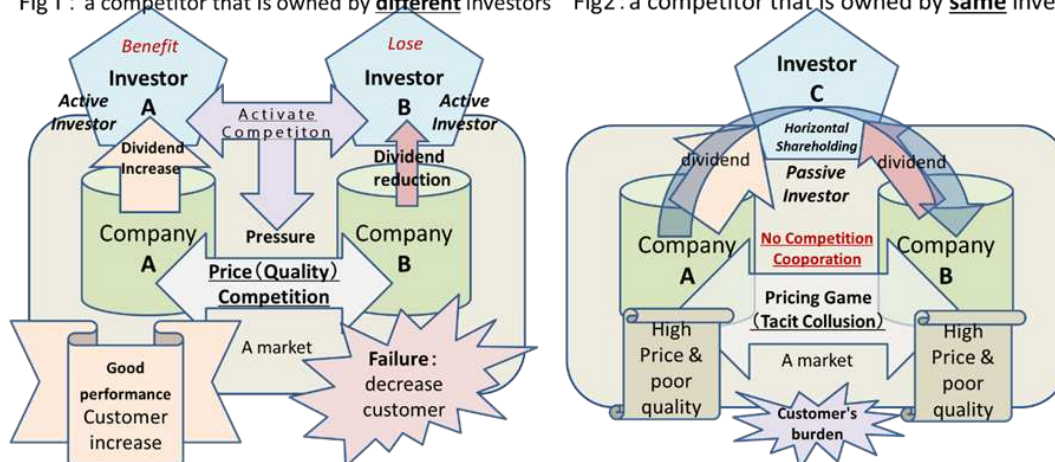
2   Game theory

The "game" in game theory denotes the interaction between parties that are acting in their own interests. It could, therefore, also be called "interaction theory", and is

applicable to the phenomenon of tacit collusion in the oligopolistic market. Two types of game are distinguished: cooperative and non- cooperative.

- *Cooperative game*; A game is cooperative if the players can form binding commitments that are externally enforced (e.g. through contract law). Cooperative game theory model scenarios, when agents can benefit from cooperating, and binding agreements are possible. In cooperative games, actions are taken by groups of agents, coalitions (Fig. 2). This diagram schematically shows investor C who holds both shears of company A and B. Investor C player plays a role as a horizontal investor, as explained below (OECD, 2017).
- *Non-cooperative game* (Competition on the market); A game is non-cooperative if players cannot form alliances or if all agreements need to be self-enforcing. The traditional non-cooperative game focuses on predicting individual player's actions. Also, the critical feature of a non-cooperative game is the absence of an external authority to enforce rules. For example; A sharing of information between competitor A and B is not permitted under the Sherman Act and the U.S. federal antitrust law (Department of Justice) or "Gesetz gegen Wettbewerbsbeschränkungen (GWB) [Bundesministerium der Justiz und fur Verbraucherschutz]" and "Japanese Act on Prohibition of Private Monopolization and Maintenance of Fair Trade [Japanese Law Translation]".

Figures 1 and 2 schematically illustrate a common non-cooperative situation [Mizuta, 2018]. Company A and B are competing for each other. There are several types of competition, which act for and against each other, such as a Joint venture, co-oporation, alliance, original equipment manufacturer (OEM) and Japanese "Keiretsu". The degree of connection between companies A and B will crucially affect how their specific resources will be exchanged in the combined situation. Here, both companies are rational economic agents who separately achieve their own goals. Usually, companies are owned by investors, here designated as unrelated investors A and B. Their behaviour will be that of their respective company A or B.

Figures 1 and **2.** Conceptual diagram for **different** and the **same** investor.

Generally, a shareholder can influence a company's activities. Notably, a majority shareholder, who usually owns more than 50% of a company's shares, can play an important role. This majority shareholder has more power than all of the other shareholders combined, and has the authority to do things that other shareholders cannot, such as replacing a corporation's officers or board of directors. However, the attribution of these majority shareholders gradually changes into horizontal shareholding, which is discussed in Section 2.1 below.

In the context of corporate governance, separation of ownership and management means that the management of the company can authorise its activities under dispersed ownership; no one shareholder has enough shares to be able to control the company. There is also the stakeholder's view of a firm. In defining "Stakeholder Theory" Freeman (2010) states: "The firm is a system of stakeholder management within the larger system of the host society that provides the necessary legal and market infrastructure for the firm's activities" (Freeman, et al., 2010). Business is about how customers, suppliers, employees, financiers (e.g. stockholders, bondholders, banks), communities and managers interact and create value. Therefore, "Stakeholder Theory" and a cyber-platform can deal fairly well with "Game Theory".

Figure 1 shows a competitor that is owned by **different** investors. These are investors who are actively involved in formulating strategy for companies A and B, so-called active investors. Figure 2 shows a company that is owned by the **same** investor. The investor is not involved in strategy formulation, and is thus called a passive investor (here, investor C).

Figures 1 and 2 illustrate the analysis for maximum profit (dividend) for investors A and B, and investor C, in the two scenarios. The active investors in Fig. 1 are expected to promote competition between companies A and B and within the market at large. In contrast, investor C (in Fig. 2) reduces risk through passive investment, in comparison to the reduction of dividends by competition between companies A and B. Investor C, therefore, creates a stable profit condition. For example, ETFs track stock indexes. A stock index is computed from the prices of selected stocks (typically a weighted average). The selected stocks are chosen according to many factors such as a market-cap, free-float and other portfolio-related criteria.

- *A passive investor* (investor C in Fig. 2) invests for the long haul. Passive investors are based on a "random walk", which is a statistical phenomenon. The passive investor believes a variable follows no discernible trend and moves seemingly at random. Malkiel's random walk theory points out that the price of securities moves randomly, therefore, it is impossible to predict future price movement, either through fundamental or technical analyses. One type of passive-investor style involves a buy-and-hold mentality (Malkiel, 2019).

- *An active investor* takes a hands-on approach and requires that someone act as portfolio manager. The goal of active money management is to beat the stock market's average returns such as that of the DAX30 or other leading indexes. A hedge fund uses this investment style. A portfolio manager usually supervises analysts who examine qualitative and quantitative factors.

2.1   Horizontal shareholdings

Horizontal shareholdings have overlapping ownership by financial investors. It exists when a standard set of investors own significant shares in corporations that are horizontal competitors. Institutional investors have become leading shareholders in the airline, banking, computing and pharmacy markets. Several empirical studies have confirmed that these horizontal shareholdings have anticompetitively affected airline and banking markets (Einer, 2017).

Institutional investors are specialised financial institutions that invest capital from a large number of investors on their behalf, pursuing the goal of maximising returns at a reasonable risk. Institutional investors include insurance companies, asset managers, investment and pension funds, as well as banks and sovereign wealth funds. The German Monopolekommission focuses on investigating equities and differentiating between active and passive investment strategies (Table 1). Active investors may choose between value, growth and combination strategies (e.g. growth at a reasonable price (GARP)). Passive investors seek the performance of an index, such as using ETFs. In the context of the DAX, the most important German stock index, the share held by institutional investors in 2017 represented 61.8% of the free float, while private investors accounted for 17.2% and strategic investors 18.4%. Strategic investors are anchor investors such as families (companies), foundations and strategic participations of the Federal Republic of Germany (Table 1) (DIRK, IPREO, 2018). The Top 10 investor group of the DAX 30 index shows the value held by specific institutional investors, e.g. BlackRock, which accounted for 10.1%. Notably, the Top 10 investors collectively held more than one-third of the value of the DAX30 index.

Table 1. Top 10 Investor group of DAX 30 index

Rank	Group	Value on DAX in 2017（Mio $）	Account of DAX　%	Passive or Active	Country
1	**BlackRock, Inc.**	72,152.00	10.10%	Aktive&Passive	USA
2	**The Vanguard Group, Inc.**	29,802.50	4.20%	Passive	USA
3	**Deutsche Bank AG**	29,254.20	4.10%	Akive	Germany
4	**Norges Bank (Norway)**	25,905.00	3.60%	Aktive	Norway
5	**State Street Corporation**	23,417.80	3.30%	Passive	USA
6	Credit Agricole (Amundi)	17,529.80	2.50%	Aktive&Passive	France
7	Societe Generale (Lyxor)	15,904.60	2.20%	Passive	Germany
8	BPCE S.A. (Harris Associates)	15,541.20	2.20%	Aktive	Swiss
9	UBS AG	15,470.60	2.20%	Aktive	France
10	Allianz SE	14,826.70	2.10%	Aktive	Germany
	Total	259,804.40	36.50%		

参照: Deutscher Investor Relations Verband und Ipreo

3   The several Signals (Artificial intelligence, Machine learning and Deep learning)

Regarding the use of computer techniques below will create more secret collusion, and as a result, manipulates a price setting. The stronger, more powerful algorithms will likely prevail and dominate the market. A simple scenario, we use computers to execute their instructions directly. Firms are owned by overlapping sets of investors (passive investors), and their incentives to compete are thereby reduced, explained about 2.1 Horizontal shareholding. The computer techniques are developing step by step see 1 to 3 below.

1. Artificial intelligence (AI)

Chaos data (now referred to as 'big data') are generated through our daily experiences. Norbert Wiener first suggested that chaos data could be regulated and organised using cybernetics as an approach to controlling the chaos (Norbert, Wiener, 1950) and he now considered to have been a pioneer in artificial intelligence (AI). The signals involve the following concepts: artificial intelligence (1950s-), machine learning (1980s-) and deep learning (2010s), in chronological order.

2. Machine learning

The machine is "trained" using large amounts of data and algorithms that enable it to learn how to perform a task. There are several types of learning pattern: 1. Supervised learning; the computer learns a general rule. 2. Unsupervised learning; no labels are given to the learning algorithm so that the hidden structures or patterns in the data may be discovered. 3. Active learning; the computer can only obtain training labels. 4. Reinforcement learning; feedback is given to the program's actions in a dynamic environment, such as a self-driving vehicle.

3. Deep learning

As you know, Go is a strategy board game for two players. The game was invented in China more than 2,500 years ago. Alphabet Inc. (Google DeepMind) developed AlphaGo what is a computer program for playing the game of Go. AlphaGo has beaten a human professional Go player, who is the world No.1 ranked player, Ke Jie in 2017. AlphaGo's algorithm uses a combination of machine learning.

3.1   Pricing Game

An agreement may be established as humans collude through the medium of computers (Table 2). The computer algorithms serve as the messengers in the sense that the cartel members program the computers to help the cartel. Table 1 shows three types of collusion: "messenger", "hub-and-spoke" and "autonomous machine". However, these are only recognised behind closed doors (tacitly).

- *Messanger;* This type of collusion occurs when a competitor agrees to use the same pricing algorithm under the same conditions, even if there is no agreement on direct price. As with the agreement to use the formula, the cartel is also established under the traditional cartel concept.
- *Hub and Spoke;* If a competitor happens to use the same pricing algorithm provided by a third party, it does not immediately cause a problem with respect to antitrust law. However, in the case where competitor price data themselves are shared through third parties and they are mutually recognised, a hub-and-spoke type of cartel may result.
- *Autonomous Machine;* When autonomous pricing algorithms make price adjustments irrespective of the intention of the operator, there is no artificial interaction between competitors. The cartel concept can be difficult to apply in such a situation.

Table 2. Computer collusion scenario (Ezrachi , et al., 2015 p. 1784)

Model of collusion	Usage/Type/ characteristics of	Evidence of agreement
Messenger	Competitive companies use the same pricing algorithm	Strong evidence of horizontal agreement
Hub and Spoke	Machine Learning	likely effect
Autonomous Machine	Deep Learning	Unclear

4 Asset under Management

"Horizontal Shareholding", mentioned above section 2.1 based on respect to passive funds. Horizontal shareholding means that funds investing in shares will be majority shareholders of many companies in one industry. Usually, investors will apply pressure on corporate managers to increase the competitiveness of the holding company, which will win market share and the corporate value will rise. This will drive up the stock price and improve profit.

However, the situation will be different for the investor who holds shares of many companies in the same industry. A highly competitive market will lead to price reductions and, thereby, a loss in value of the company. There is a possibility that the total profits of both companies could actually be higher in such a situation, not because of price competition but, rather, because of "tacit collusion" in a low-growth market.

The shareholding structure may support such tacit collusion. Global assets under management are expected to rise from US$84.9 trillion in 2016 to US$145.4 trillion in 2025 according to PricewaterhouseCoopers (PwC). This firm predicts a compound growth rate of almost 6%. Figure 3 shows the share of active, alternative and passive global assets under management. Traditional active management will continue to be

the core of the industry in 2025. However, it will grow at a less rapid pace than the passive and alternative strategies.

PwC forecasts that active management will decrease from 71% in 2016 to 60% in 2025. Passive investment will gain significant market share, rising *from 17% to 25%*, while alternatives will increase from 12% to 15% over the same period. Passive investment will more than double, from US$14.2 trillion to US$36.6 trillion because of cheap passive ETFs. Alternatives will increase from US$10.1 trillion to US$21.1 trillion.
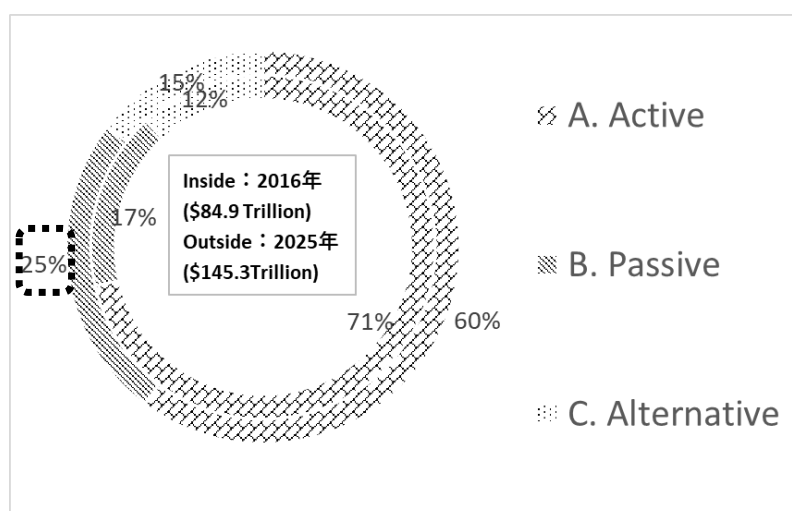

Fig. 3. The active, alternative and passive shares within global assets under management (PwC, 2017).

5   Conclusion and Solution

In this paper, a structural investigation of tacit collusion was presented by adopting a two-step approach. **First,** pricing mechanisms are slowly shifting from traditional techniques to a new "pricing game". Moreover, new forms of collusion have emerged, including horizontal agreement, as a result of computer algorithms that exert their influence covertly.

Second, firms are owned by passive investors, such as the "Big Three" institutional investors (BlackRock, Vanguard and State Street). Investors are shifting their money into ETFs, particularly as they can offer lower operating costs, flexible trading and superior risk diversification. ETFs are also a favourable counterbalance to the excess liquidity that has afflicted central banks since the financial crisis began in September 2008. However, despite the convenience of ETFs, their character can accelerate the hollowing-out of voting rights (corporate governance). Corporate governance is defined as the relationship between a company's stakeholders, management and board of directors, and has a significant influence on that company's operation. The Big Three are incapable of executing their voting rights without their workforce.

BlackRock continues to be an important and very large investor in Germany (Deutschland-AG) with an actual share of 6.1% of the institutional free-float. BlackRock holds $2.1 Mrd in the DAX (German stock index; $2,1 Mrd.) (DIRK, IPREO, 2018). They also have $4.7trn assets under management. The NYSE market

capitalisation will be around $19trn, that is, almost one-quarter of the entire market (Azar, et al., 2017).

*Family ownership may offer a **possible solution** and to offer a countervailing power against this situation, for healthy competition. The motivation for the family-shareholding is focusing on the company's governance, rather than the intention of profit maximisation of institutional investors.* For example, according to Fig. 4. the historical shareholding structure of DAX30, family ownership holds a share of 19.01% compared to that occupied by overseas investors at 16.58% (Monopolkommission, 2018).

The shareholding structure categorises identifiable capital shares exceeding one per cent according to the nature of the shareholder. It identifies whether the equity interests of shareholders are held by the Top 100 companies, foreign investors, the public sector or individuals, or families or family foundations. Figure 4 shows the historical shareholding structure from 1982 to 2016. The shareholders fall into the following six categories:

1. ***Free-float***; This refers to the number of outstanding shares that are available to the public for trade. Free-float market capitalisation is calculated by multiplying the equity's price by the number of shares in an index, such as the DAX30. It is important to identify all of the active and inactive shares for the calculation. The free-float excludes locked-in shares such as those held by the Top 100 companies, and shares owned by families, the general public and governments as below.
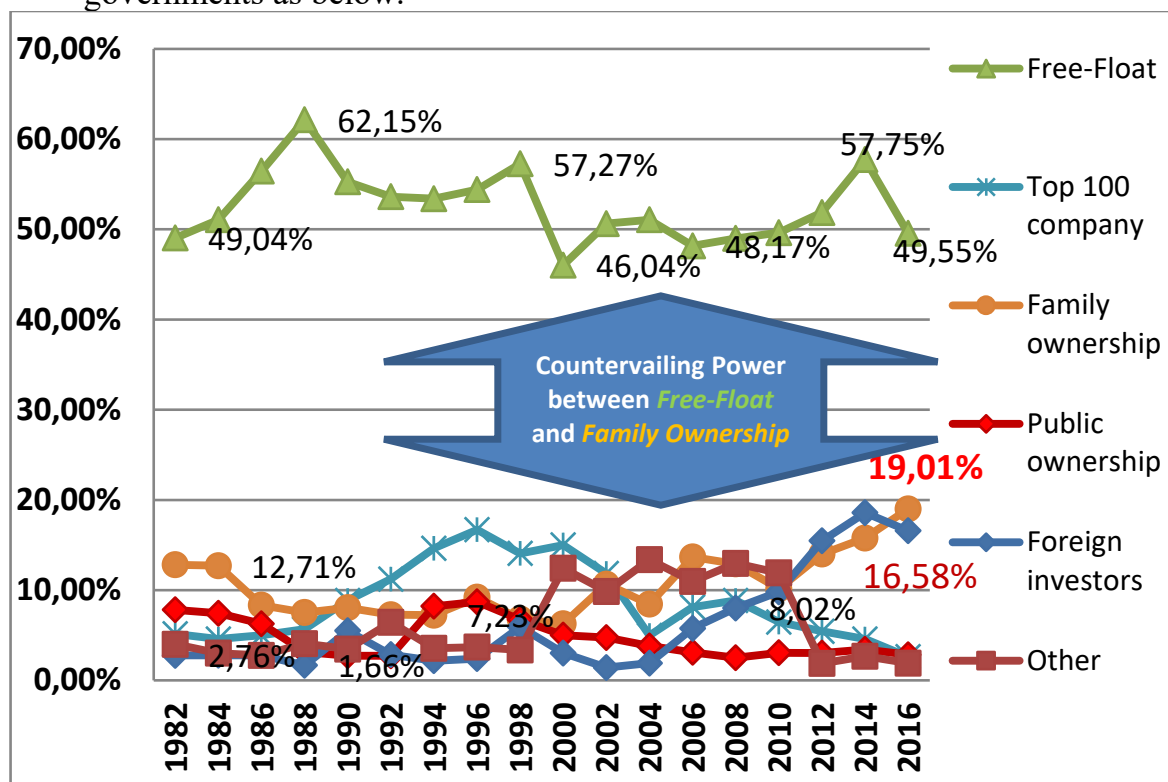

Fig. 4. Historical shareholding structure of the DAX30

This Free-float ownership, held by institutional investors, need to be countervailed by family owners (19.01%) against this free-float (49.55%), see Fig. 4

below. Free-float is applied by especially passive investors for grounding their precondition what explained in Fig. 3. before.

2. ***Family ownership***; This category includes ownership by individuals or family foundations. Family ownership has a direct or indirect majority (in the sense of the regular majority of capital or voting rights in shareholders' meetings); one or more families can be involved. Also, family ownership must (in some way) influence the company's strategy (Prof. Dr. Kirchdörfer, 2011). Fig. 4. shows that the family ownership (19.01%) is exceeded the overseas investors (16.58%) in throughout the 2000s when globalization progressed. In addition, family ownership is favoured by regulators because of their creation for attractive employment opportunities.

3. *German Top 100 company*; These companies create significant economic value and employment. Fig. 4. illustrates the ownership ratio of the Top 100 companies has decreased slightly over the past 15 years.

4. *Public ownership*; Figure 4 shows that public ownership has also decreased markedly over the past 20 years. However, the public sector plays a very important role from the socio-political perspective. It comprises the governing bodies that are political decision-makers. Public sector representatives as policy-makers are predominantly found in the boards of directors of companies in which the public sector also holds shares of capital. The importance of this category has also diminished, due to the privatisation of major energy suppliers such as RWE AG in Germany. The public sector offers a certain framework to create a countervailing structure between the free-float and family ownership, as noted above.

5. *Foreign investors*; An allocation to the "identifiable foreign investors" category only takes place insofar as the available data sources explicitly include investments by foreign investors, which in each case must exceed one per cent.

6. *Other*; Shares of companies outside the German Top 100 companies and institutional investors in Germany as well as capital shares of co-operatives and unidentifiable participations are included in this category.

It could be a very natural step toward setting up a foundation for a big family-owned corporation for Tax reason, primarily a social responsibility for the public.

Between 2006 and 2014, the domestic employment figures for the 500 largest family firms in Germany increased from 2.67 to 3.17 million to almost 19%. In comparison, the 27 DAX-listed companies recorded only a 1.5% growth in employment over the same period (Dr. Gottschalk , et al., 2017). Also, A variety of the corporate form is also helping to increase family businesses such as the foundation for public interest. For example, Volkswagen AG is governed heavily from the foundation of the Porsche and Piëch families, such as the Ferry Porsche foundation. This foundation sacrifices only their dividend from their shareholding but keeps Governing power to the company.

The branding strategy (a dependence effect) of those family-owned companies will also be the research subject, which is heavily causing a vertical and horizontal inte-

grated structure not only for their physical production but also their virtually created brand-image.

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