Gafam Market Power: the role of a firm's age, data, and overlapping economic activities in merger and acquisition strategies

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Année académique : 2021-2022
URI/URL : http://hdl.handle.net/2268.2/14233

GAFAM MARKET POWER: THE ROLE OF A FIRM'S AGE, DATA, AND OVERLAPPING ECONOMIC ACTIVITIES IN MERGER AND ACQUISITION STRATEGIES

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Master thesis by
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For a Master in Economics,
specializing in
Economic Analysis and Policy
Academic year 2021/2022

Acknowledgements

Throughout the writing of this master thesis I have received a great deal of support and assistance.

First, I would like to thank my master thesis supervisor, Professor Axel Gautier, for agreeing to supervise my master thesis and for giving me the opportunity to work on this interesting topic. Furthermore, his expertise and work on the topic of "Mergers in the Digital Economy" sparked my interest in the subject and helped me formulate my research questions and methodology.

Second, I would like to express my gratitude to Laureen De Barsy for reading my master thesis and for her valuable advice and kind help in designing my master thesis.

Third, I would like to acknowledge Professor Pieter Van Cleynenbreugel for reading my master thesis.

Fourth, I would like to thank all the administrative personnel at HEC Liège who have been involved in making this Master thesis possible.

Fifth, I would like to thank my proofreaders Anna, Myriam, Felix, Mut, and Mike for correcting and critically reviewing my Master thesis.

Sixth, I would like to thank my family and beloved who supported me during this time and who provided a cheerful distraction to calm my mind.

Last, I would like to thank my two grandparents, Maria Kinn and Fernand Schiltz, who unfortunately left us during my last Master's year. They have always supported me from a very young age to complete my studies as well as possible and their biggest dream would have been to see me graduate from university.

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GAFAM: ”GAFAM is an acronym for five popular U.S. tech stocks: Google (Alphabet), Apple, Facebook (Meta), Amazon, and Microsoft”(Mitchell (2020)).

M&A: Mergers and acquisitions

AMZN: Amazon.com, Inc.

APPL: Apple Inc.

FCBK: Meta Platforms, Inc.

GOOG: Alphabet Inc.

MSFT: Microsoft Corporation

DC Digital content cluster

HW: Home, well-being, and other personal needs cluster

RS: Remote storage and file transfer cluster

AI: Artificial intelligence, data science, and analytics cluster

TD: Tools for developers cluster

O: Other cluster

PGS: Physical goods and services cluster

CAT: Communication apps and tools cluster

ATP: Advertising tools and platforms cluster.

EUMR: European Union Merger Regulation

VR: Virtual Reality

DBE: Digital business ecosystem (Moss et al. (2021))

1 Introduction

The introductory chapter of this thesis is divided into two parts. First, the topic of the thesis is discussed by placing it in context and by highlighting the relevance. Second, the objectives and structure of the thesis are presented.

1.1 Context & Relevance

Large technology companies are playing an ever-increasing role in everyday life and are constantly expanding their range of goods and services. Google, Amazon, Facebook, Apple, and Microsoft (GAFAM) are among the most important companies of our time, not only in terms of revenue, but also in terms of social impact. With their innovative products and services, they are constantly attracting new users that gather on their platforms and over the years, they have managed to secure their dominant positions in the digital markets. Major technology companies are involved in a large number of mergers and acquisitions (M&A) of companies operating in all kinds of economic sectors every year. GAFAM alone concluded 329 mergers and acquisitions between 2015 and 2021. These circumstances cause concern for competition authorities, as the background to this large number of annual transactions is not always clear. This ambiguity is indicative of a research gap in this area. With few exceptions, there are no formal reviews of recent merger and acquisition transactions by large technology companies. The high number of transactions mainly concerns technology companies that already dominate the market and gives rise to fears that these transactions serve the purpose of further expanding dominant positions. A number of mergers and acquisitions are specifically aimed at young companies with innovative products and that are still at the beginning of their development or at companies that are active in the same area of economic activity. The increasing importance of Big Data, cloud computing and artificial intelligence (AI) is also reflected in merger and acquisition strategies, which suggests that data serves as a means for dominant companies to gain greater market power. This greater market power can then be used in an anti-competitive way. In some cases, the acquisitions are aimed at the acquirer ceasing the activities of the acquired or merged companies, which reduces the future competitive pressure on the incumbents. Thus, it is relevant to understand why certain companies are dominant and use mergers and acquisitions in an anti-competitive manner or for anti-competitive practices, and what can be done at the policy level to make the responsible companies refrain from doing so. In this regard, the following research question is formulated:

How can age, data, and overlapping economic activities of a target company in the context of merger and acquisition strategies explain the market power of GAFAM?

On top of the above factors, this thesis also explores for other factors that might be related to the market power of GAFAM. Therefore, an additional research question is formulated:

How can total funding and origin of a target company in the context of merger and acquisition strategies explain the market power of GAFAM?

1.2 Aim & Structure

In the context of the above research questions, this paper aims to disclose the merger and acquisition strategies of five leading technology companies of the digital economy and to reveal possible rationales behind the latter strategies. In particular, the age of the acquired entity, overlapping economic activities, and the role of data are highlighted in this study. In addition, this study explores the role of total funding and origin of the acquired companies in the M&A strategies. The five companies in question are GAFAM (Google (Alphabet), Apple, Facebook (Meta), Amazon, and Microsoft), which are among the top ten companies with the highest market capitalisation in the world (As of May 2022). This study is conducted on the basis of published data on mergers and acquisitions of GAFAM for the period 2015 to 2021. Moreover, cases of post-acquisition company shutdowns by GAFAM will be investigated, which can be used as an anti-competitive tool by incumbents to gain market power. Age, data, overlapping economic activities, total funding, and origin of the acquired companies are analysed as drivers of discontinuation decisions. Once the roles of the latter factors are identified, alarm signals for cases with a potential anti-competitive motive will be formulated. With the help of the latter, competition authorities are able to detect them at an early stage. This study complements existing studies and provides relevant and new insights into the merger activities of GAFAM and into competition in the digital economy.

The introduction chapter is followed by the developments chapter of this thesis. First, an introduction to the relevant literature is given by discussing key characteristics of the digital economy and the context of mergers and acquisitions for leading technology companies. The aim is to understand why certain companies have dominant market positions and resort to mergers and acquisitions, which sometimes have anti-competitive motives. In the methodological part of the study, the data sources are discussed first. Then, the areas of economic activity of GAFAM are divided into 9 groups based on the annual revenues disclosed in the annual 10K filings to determine their active and main business areas. With this information, it is possible to gain a better insight into the business models of GAFAM and to identify the main activity of each GAFAM member based on its largest annual source of income. This analysis is followed by a retrospective analysis of GAFAM transactions. For this purpose, detailed summary statistics are presented, which form the basis for the review of the merger and acquisition history of GAFAM. In particular, factors such as age, the overlapping economic activities, cloud infrastructure activities, total funding and the origin are given emphasis. The following part of the thesis discusses the drivers of GAFAM's post-acquisition decisions to discontinue companies. Subsequently, a policy recommendation with regard to the new insights of this thesis is given. Finally, the thesis ends with a conclusion chapter.

2 Developments

2.1 Literature Review

The developments chapter begins with a literature review. This is followed by a section on the methodology used in this thesis. In the next section, the thesis deals with descriptive statistics on past GAFAM transactions. Thereafter, the drivers of company shutdown decisions by GAFAM are investigated. Finally, the developments chapter ends with a policy recommendation based on the findings of the two previous sections.

2.1.1 Key characteristics of the digital economy

The digital markets are characterised by numerous mergers and acquisitions carried out by leading digital companies. GAFAM alone concluded 329 mergers and acquisitions between 2015 and 2021. In the first place, it is fundamental to understand why these large technology companies, e.g. GAFAM, are in the privileged position to engage in considerably more acquisitions and mergers than other companies in the digital economy. According to the report of the Directorate-General for Competition of the European Commission, the dominant position of these giant players can be traced back to key characteristics of the digital economy (Crémer et al. (2019)). First, economies of scale for digital products are extremely high. High fixed costs and low variable costs are the hallmark of digital products. This strong cost efficiency can thus confer a competitive advantage on these companies that is difficult for rivals to challenge. Second, Crémer et al. relate the incumbency advantage of Big Tech companies to network effects. The utility of a user increases with the number of users of a digital product, such as online platforms (e.g. a social network). The more users join a platform, the higher the utility for these users and the more new users switch to the platform because of the higher utility on this platform. This means that it will be even more difficult for the competitor to convince the larger number of users on the incumbent platform to switch to its own platform. Third, dominant companies have more data and more advanced technologies and knowledge to collect, store, and use big data sets. As a result, their ability to develop innovative digital products and services is enhanced. Furthermore, there is another fundamental feature of the digital economy that explains the dominant position of some large technology companies. Digital markets are highly concentrated, and big tech companies tend to ”organize in conglomerates” by developing products in the same field as their existing products, which further strengthens their dominant market positions (Bourreau and Perrot (2020)). The authors attribute this natural concentration process of the digital giants to two of the characteristics of the digital economy described above, namely economies of scale and network effects. These conglomerates are characterised by one company consisting of many other, sometimes disjointed, companies, with the main company holding the decisive share in the smaller, independently operating companies (Chen (2022)). The next step is therefore to examine what role mergers and acquisitions play for dominant positions.

2.1.2 M&A and dominant positions

Consideration must be given as to why GAFAM are involved in such a high number of transactions. Bourreau and Perrot attribute GAFAM's incumbent advantage to the numerous acquisitions and mergers of start-ups in which they are involved, allowing their conglomerates to expand and gain dominant positions in the market (Bourreau and Perrot (2020)). According to Gautier and Lamesch (2021), the first reason GAFAM use mergers and acquisitions is to further expand their conglomerates to attract consumers to their platforms. Expanding the range of products and services to attract consumers is

therefore the normal course of competition in the digital markets and a way for the company to grow bigger. The second reason GAFAM acquire start-ups is that they might be interested in some of the assets they own (Gautier and Lamesch (2021)). In the paper "platform mergers and antitrust" by Parker et al. (2021), the authors explain that big tech companies can have different reasons to resort to mergers and acquisitions. They might be particularly interested in the human capital of a startup, or in its technology (e.g. patents), or in its products, or in its channels of distribution. Also, the user base of the company may represent an interesting asset. Thus, the acquired assets complement the activities of the company, as they would enable the company to increase returns to scale, to benefit from network effects and to be more innovative, thanks to more data. The third reason mentioned by Gautier and Lamesch (2021) is to restrict competition and strengthen the market position. From a competition law perspective, Argentesi et al. (2021) explain that when incumbents in digital markets acquire early-stage firms, the goal of these acquisitions is often to hinder the evolution of a potential competitor because it develops an innovative idea that poses a potential future competitive threat. However, this acquired innovation might not be used by the incumbent to advance, but to strengthen its market leadership. Incumbents can resort to two different options to prevent the development of a competitor. First, they can directly acquire a dangerous competitor and eliminate the competitive threat by bringing the acquired company under their control. Second, they can acquire a competitor indirectly by buying a firm that provides "complementary or otherwise related services" to the competitor. In this way, the incumbent acquires the related business before the competitor can do the same, preventing it from improving its products and challenging the incumbents with those improved products.

2.1.3 Protection of market positions

Gautier and Lamesch (2021) analyze thoroughly the strategic backgrounds of mergers and acquisitions. Apart from "developing their ecosystems" and the interest in the production factors of the startup, Gautier and Lamesch identify another reason to acquire an innovative startup. The "pre-emptive strategy" consists in acquiring startups with good prospects for success in order to eliminate the competitive threat and to defend their market positions (Gautier and Lamesch (2021)). If the acquired start-up is closed after the acquisition, the pre-emptive strategy becomes a killer merger strategy. Using publicly available data on GAFAM acquisitions between 2015 and 2017, the authors find that in most M&A cases, the acquired company ceases to operate after the acquisition (Gautier and Lamesch (2021)). Concerns therefore arise that Big Tech companies become too strong and use acquisitions and mergers in that way in order to reduce competition, especially in regard to "killer mergers" which consist in discontinuing startups post acquisition, according to the latter. When it comes to killer acquisitions, Cunningham et al. (2021) investigate their existence in the pharmaceutical industry using the *Pharmaprojects* database, which tracks the evolution of drug projects from their inception. They find that incumbents acquire innovative start-ups, and they discontinue firms in order to prevent future competition, especially when the drugs produced by the innovator are "overlapping with the drugs produced by the incumbent". The authors suggest that such analysis should also be done for the tech sector in order to sufficiently scrutinize the impact of such activities on innovation in that industry.

2.1.4 Consequences of M&A for competition and innovation

Competition law has the task of scrutinizing anti-competitive behaviour and preventing companies from engaging in such behaviour in order to promote competition in the markets. Also, it is in charge of protecting the interests of consumers. However, competition between large technology companies, which tend to be organised in conglomerates, takes the form of innovation (Crémer et al. (2019)). According

to Crémer et al., digital economy innovations have improved consumer welfare in many areas of daily life. They have also enabled companies in the digital economy to become more efficient through innovations in data technology. In this context, Katz shows that innovation plays a major role in merger and acquisition strategies. In the presence of strong network effects, a promising startup could overcome a dominant incumbent, if its innovation manages to convince consumers of its merits, according to Katz (2021). If that happens, more and more users will be convinced and the firm will experience a positive evolution. This might lead to a situation where the quality of a product of a startup outweighs the economies of scale advantage of a dominant tech company. Consequently, the dominant firm wants to get rid of the threat posed by the innovator, for example with the use of mergers and acquisitions. Kamepalli et al. (2020) provide empirical evidence of a "kill zone" in the digital economy due to the increased number of mergers and acquisitions, including killer mergers. The authors use data on acquisitions of software companies by Facebook and Alphabet provided by *Pitchbook*, a research and technology database for private capital markets (Wikipedia (nd)). According to the authors, intense merger and acquisition strategies dissuade potential companies from entering the market, leading to fewer investments in early-stage companies and therefore to a lack of innovation in digital markets and a lack of competitive pressure on dominant incumbents. This competitive threat always kept powerful digital players at bay, meanwhile they can bypass this sort of threat easily thanks to their financial resources. As a result, mergers and acquisitions need to be taken into account by competition authorities as they affect innovation and thus competition in digital markets.

2.1.5 Exit Strategy

In the technology industry, start-ups increasingly rely on funding from venture capitalists (Lemley and McCreary (2021)). Small start-ups resort to this type of financing when they do not have access to funding from capital markets (Hayes (nd)). Hayes also explains that venture capitalists invest in young start-ups because they have high growth potential and want to make profit by selling their share of the start-up's equity at a later time. In this context, Lemley and McCreary (2021) explain that successful venture backed start-ups tend to focus on the "exit strategy" and being acquired by a dominant incumbent, as venture capitalists seek a quick return on investment. This exit strategy thus helps the big tech companies to consolidate their dominant position, either by acquiring an innovative new technology from a start-up or by acquiring it and shutting it down. This paper examines the role of start-up funding in GAFAM merger and acquisition strategies. The intuition is that higher financing indicates high growth potential. This high growth potential could be an indication of an innovative new technology that a start-up company is developing and the possibility of becoming a threat to the incumbents. This could lead to a higher likelihood of discontinuation as the acquisition could be motivated by the assets or the removal of a competitive threat. In addition, it is important to investigate whether start-ups founded in the US are more involved in these types of mergers and acquisitions than start-ups founded in the rest of the world. Lemley and McCreary (2021) state in their paper that "in Silicon Valley, the most important thing to think about when starting a company is how you're going to end it". This perhaps indicates that there is a different start-up culture in the United States than in the rest of the world, as investors often seek a quick return and company founders seek the know-how of a large technology company (Lemley and McCreary (2021)).

2.1.6 Role of data

In addition to the anti-competitive practices already mentioned, which serve to support the dominant position of the incumbent, the importance of data is on the rise. According to the American Antitrust

Institute, cloud infrastructure assumes a central role. It comprises ”cloud technologies, data analytics, Artificial Intelligence (AI), and machine learning” (Moss et al. (2021)). In the report, the authors study the growth of digital business ecosystems (DBE) through mergers and acquisitions. They refer to data on acquisitions by ”five of the largest digital business ecosystems”, e.g. GAFAM, between 1987 and 2020. For this data, they look closely at how many GAFAM acquisitions during this period were related to cloud infrastructure and find that by 2010, most of the large technology companies had focused on developing cloud infrastructure. With the help of the latter, large digital companies can gather, merge and process large amounts of data. Thus, acquisitions in the field of AI and machine learning are also playing a role in improving the cloud infrastructure of the incumbent. Moss et al. (2021) note that economies of scale are essential for value creation in digital business ecosystems, as they enable the incumbent to capture and process large amounts of data at low cost. This processed data, combined with AI and machine learning, enables large digital business ecosystems to learn more about ”the shape of consumer preferences”, which is of great value to advertisers interested in personalising ads based on consumer characteristics (Moss et al. (2021)). Consequently, economies of scale in cloud infrastructures consolidate the dominant position of an incumbent. Due to the high concentration of cloud infrastructure of the incumbent, competitors can not challenge them on a level playing field. Therefore, cloud infrastructure becomes a barrier to entry for smaller digital business ecosystems, which may suffer from these and other anti-competitive practices by the incumbent. The implication is that greater market power might entail that it is used for anti-competitive motives.

2.1.7 Regulatory Framework

Both the large number of mergers and acquisitions and the growing role of data underline the need for an effective legal framework. The purpose of such a legal framework is to ensure effective competition. Effective competition is beneficial to consumers as they face lower prices, more innovative and high quality products and, a larger choice of goods and services offered on the market (Council of European Union (2008)). If this is not the case, then all this accrues to a dominant company, which itself determines price, quality, choice, and innovation. For this reason, antitrust authorities and regulations are in place to prevent this from happening. In addition, this legal framework is intended to prevent problems related to the concentration of large technology companies that acquire significant numbers of companies (Holmström et al. (2018)).

For the European Union, the EU merger control regime consists of jurisdictional thresholds defined in Articles 1(2) and 1(3) of the European Union Merger Regulation (”EUMR”) that trigger the obligation to notify the merger to competition authorities (Crémer et al. (2019)). After the notification, the merger is brought under investigation and may also result in intervention or sanctions by the competition authorities. The thresholds are based on the turnover of the acquired entity. If the turnover threshold is not reached, the merger can still get under investigation if the companies concerned or member states concerned request it. The concerned states might notify the mergers because the merger represents a threat to trade between member states or to competition within the territory. For the US, the ‘Hart-Scott-Rodino Act’ defines the merger notification regime (Ostoyich and Oliver (2022)). This act contains 3 thresholds or tests which determine if the merger needs to be notified or not. These 3 tests are the ”commerce test”, the ”size-of-transaction test” and, the ”size-of-population” test (Ostoyich and Oliver (2022)). The first test is almost always met, if one of the other two thresholds is met. For the ”size-of-transaction test”, the acquirer needs to hold ”voting securities, assets and/or non-corporate interests in the acquired company that have a value of more than $90 million (Ostoyich and Oliver (2022)). The threshold is revised every year by the Federal Trade commission. The ”size-of-population” test applies

when the second threshold is met and states that the acquirer and the acquired company need to have annual net sales of $180 million and $18 million or more, respectively.

2.1.8 Shortcomings of the Regulatory Framework

However, the current legal framework is disputed in the relevant literature. In the report ”Competition policy for the digital era” by Crémer et al. (2019), authors discuss the EU jurisdictional thresholds for merger and acquisition transactions and consider that these thresholds do not represent well the relevance for competition in the digital economy. Young companies do not directly generate a high turnover and especially not high enough to exceed the notification threshold. Instead, they focus on developing a successful product and on building a user base, rather than generating turnover in the short term (Crémer et al. (2019)). Due to an early acquisition, the threshold is not reached and therefore the case will not be further scrutinised, even though the company would have developed a significant competitive potential in the long term. Therefore, calls are being made for lowering the turnover based thresholds and for introducing thresholds in the EU that are based on the transaction value, as is already the case for the US. Germany and Austria also already introduced the merger thresholds that are based on the transaction value (Holmström et al. (2018)). According to Holmström, merging companies can avoid the merger notification by agreeing on a transaction value that is just below the transaction value threshold. Thus, this solution might not solve the notification problem. Furthermore, lowering the revenue-based thresholds does not solve the notification problem either, as digital start-ups rely heavily on network effects and renounce immediate profits in favour of higher future profits. In addition, lowering the thresholds could increase the number of cases that exceed the notification thresholds, but for competition authorities it increases the workload because more cases are investigated in depth, but only a few of them turn out to be anti-competitive. Hence, it is important to examine the age factor in this thesis, as acquisitions of young companies are not necessarily caught by the regulatory framework. In fact, the problem is that there could also be anti-competitive practices involved.

Another point of criticism that the authors address is that the EUMR jurisdiction does not enable competition authorities to determine which mergers and acquisitions improve competition in the digital economy and those who do not (Crémer et al. (2019)). On the one hand, horizontal mergers, i.e. mergers between companies operating in the same industry, can be identified as anti-competitive, as a powerful company is remaining that combines the products and services of the two merged companies (Grant (2021)). At the time of the acquisition, the horizontal overlap between the ”core” market of the acquirer and the market of the acquired is clear (Crémer et al. (2019)). These acquisitions are accused of being anti-competitive because they consist of directly eliminating competition. On the other hand, vertical mergers and conglomerate mergers may seem pro-competitive at first, although anti-competitive practices may be lurking behind them (Crémer et al. (2019)). Compared to horizontal mergers, they do not directly eliminate competing firms in the same relevant market (Council of European Union (2008)). Vertical mergers occur between firms that are active at different stages in the same supply chain (Kenton (2020)). This type of merger typically reduces production costs of the acquirer leading to better control over production and to higher efficiency. Yet these acquisitions could, for example, hinder or disrupt a competitor’s supply chain and further strengthen the dominant position of the incumbent as it replaces the former supplier.

Similarly, conglomerates do not allow a clear conclusion to be drawn for the purposes of competition. Conglomerate mergers are mergers between firms that belong to industries that are not connected with each other (Kenton (2021)). They can occur if a firm wants to extend its range of products and ser-

vices produced or wants to enter a different market (Kenton (2021)). This type of merger is considered as pro-competitive, since the acquirer is adding complementary products or activities and therefore diversifying its own set of products and activities. Also, the merger brings the acquirer a larger user base and enhances efficiency, if the skills and procedures of the acquired firm are included. The acquirer may have an incentive to leverage its dominant position in the market of the acquired company through anti-competitive practices such as bundling, tying or foreclosure (Council of European Union (2008)). In the latter two cases of mergers, the horizontal overlap between the ”core” market of the acquirer and the market of the acquired might not be significant at the time of the acquisition. Therefore, the merger might be considered as vertical or conglomerate merger with neutral or pro-competitive effects. In reality, however, these might have anti-competitive aims. Therefore the anti-competitive nature of an acquisition might not be caught by the regulatory framework. Thus, it is relevant to sufficiently consider the overlap between the economic activities of the acquirer and the acquired.

Another point of criticism is that current merger regulations overlook the anti-competitive effects arising from economies of scale in cloud infrastructure (Moss et al. (2021)). The increased number of M&A in cloud infrastructure is an indication for concentration in cloud markets. The latter concentration leads to greater market power for incumbents, which could increase the likelihood of anti-competitive conducts that disadvantage smaller digital business ecosystems that are not as focused on cloud infrastructure. Also, economies of scale in cloud infrastructure allow the incumbent to extend its market power to other markets in which the incumbent is active. Therefore, this thesis also investigates the role of cloud infrastructure activities in merger and acquisition strategies, as the current regulatory framework neglects the associated consequences for competition.

This thesis addresses the growing fears that big tech companies are looking to strengthen their dominant positions through mergers and acquisitions. This scrutiny is essential as dominant positions and greater market power can lead to anti-competitive behaviour that is detrimental to competition and ultimately to consumers. For this purpose, the merger activities of 5 large technology companies that are considered incumbents in the digital markets are examined. This study consists of a review of GAFAM’s recent mergers and acquisitions, covering the period from 2015 to 2021 and filling the research gap of recent reviews of mergers and acquisitions. With the help of in-depth data on the age, area of economic activity, funding and, origin of the companies acquired, the aim is to find out to what extent the fears are justified that GAFAM acquire innovative start-ups in order to secure their market positions. This study also examines the decisions of GAFAM to shutdown acquired companies after the acquisition. In particular, it is examined to what extent GAFAM acquire and shut down young startups, companies with similar economic activities, or with activities in the field of cloud infrastructure. This is because these three factors are not sufficiently taken into account by the current regulatory framework. This insufficient regulation might lead to anti-competitive cases not being reported at an early stage to competition authorities. Moreover, it will examine the degree to which total funding and the origin are part of acquisition strategies and shutdown decisions by GAFAM. The aim is to understand and identify the drivers of GAFAM’s discontinuation decisions in order to formulate related warning signals for the competition authorities. Based on the findings of this study, it should be possible to develop an effective policy recommendation to effectively address the dominance concerns about the five gatekeepers of the digital economy and other leading technology companies, particularly with regard to the three shortcomings of the regulatory framework mentioned above.

2.2 Methodology

The overall analysis of merger and acquisition strategies of GAFAM provides a good starting point for investigating their market dominance and possible anti-competitive behaviour. In this context, revenue sources and acquisition history of Alphabet, Amazon, Meta, Apple, and Microsoft are analysed. This first section of the methodology part elaborates on the data sources used in the framework of this paper. For the second section, the classification and categorization of the economic activities of GAFAM and its merged or acquired companies are discussed. In the third section, the objective is to identify the sources of income based on the annual 10-K filings of GAFAM and to identify the main areas of economic activity and the areas in which GAFAM are active. This is followed by a part on descriptive statistics, which examines GAFAM's merger and acquisition strategies for the period from 2015 to 2021 to provide an overview of its activities to date. Subsequently, the part devoted to the analysis of M&A discontinuations examines the factors influencing GAFAM's decisions to shutdown acquired companies after the acquisition.

2.2.1 Data Sources

This part of the study will present the data sources used. In order to obtain an exhaustive list of acquisitions for the time period from 2015 to 2021, the respective *Wikipedia* pages of Alphabet[1], Amazon[2], Meta[3] and Apple[4] are used. For Microsoft[5], the acquisition history can be found in the investor relations section of the *Microsoft* website. This work is largely based on the paper "Mergers in the digital economy" written by Gautier and Lamesch (2021). For their paper, the authors collect data on GAFAM acquisitions for the period from 2015 to 2017. They revert to *Crunchbase*[6], a database tracking the technology sector and which gives insight into files of well-established companies, as well as into early stage startups. Using GAFAM's corresponding *Wikipedia* pages on acquisition history, a list of companies acquired by the respective big tech giants can be obtained. The companies found are searched using the names in the *Crunchbase* database. Data on foundation year, foundation country, total funding, funding rounds, operating status, and a short description of the activity of the company are extracted from this online database. Combined with the database of Gautier and Lamesch (2021), 329 merger and acquisition cases can be identified for GAFAM from 2015 to 2021. The detailed list of mergers and acquisitions can be found in Section 4.5 of the appendix.

When comparing with the relevant literature, Parker et al. (2021) identify 267 M&A cases for GAFAM for the period from 2015 to 2019 (See table 1). For this period, 264 M&A cases can be identified using *Wikipedia*, the Microsoft website and, *Crunchbase*. Hence, the database created in the framework of this paper covers more than 98% of the data collected by Parker et al. for this period. Furthermore, Moss et al. (2021) identify in their report 33 GAFAM M&A for the year 2020. For this study, 34 M&A cases are identified from the sources mentioned above. This suggests that the database created covers almost all of GAFAM's merger activities between 2015 and 2020. In addition, 31 observations for the year 2021 are included in the database, which have not been dealt with in such detail in the literature to this point and which therefore contribute to the relevance of this work.

[1] Wikipedia: The free encyclopedia (nda)
[2] Wikipedia: The free encyclopedia (ndb)
[3] Wikipedia: The free encyclopedia (ndd)
[4] Wikipedia: The free encyclopedia (ndc)
[5] Microsoft Corporation (nd)
[6] Crunchbase Inc. (nd)

	Number of acquisitions for 2015 - 2019 Parker et al. (2021)	Own database 2015 - 2019	Own database 2015-2021	Working sample 2015 - 2021 (after exclusion of data)
Alphabet	68	69	82	73
Amazon	43	43	50	45
Apple	51	50	60	55
Meta	34	32	44	40
Microsoft	71	70	93	87
Total	267	264	329	300

Table 1: Number of acquisitions by GAFAM
Source: Gautier and Lamesch (2021) and own research based on Crunchbase data

The last column of table 1 shows the number of M&A cases identified for the working sample. 29 observations are excluded from the working sample either because no information is available on the date of foundation of the acquired company or because it is not possible to determine whether the acquired company was continued or discontinued after the acquisition, based on the criteria defined in section 4.4 of the appendix. These criteria help to define the operational status of the company after it has been acquired by one of the GAFAM. If the company has been shut down after the acquisition, it is referred to as ”discontinued” in the study, and as ”continued” if it is still in operation. This part of the work can be concluded with the knowledge that the data collected is almost entirely consistent with that from the relevant literature for the period in question and that the research has identified another 31 mergers and acquisitions for the year 2021.

2.2.2 A classification of activities by clusters

After discussing the data sources, the classification of GAFAM and their 329 merged or acquired companies is required for this paper to capture the feature that economic activities vary across companies. This classification will therefore be useful for 3 reasons. First, although GAFAMs are large technology companies operating multi-sided platforms, they differ in their core business areas and main sources of revenue. This is likewise reflected in their strategy for M&A. Second, this classification is needed for the retrospective analysis of mergers and acquisitions. By categorizing the companies acquired, one can reveal potential patterns in their strategy, if the analysis exhibits a greater number of M&As in one business area, e.g. in data business and analytics. Third, it is possible to examine the overlaps between the business areas of the acquired companies and GAFAM in the M&A discontinuation analysis. Acquisitions in the core business area can be considered as substitutes for the main product of the acquirer and therefore are more likely to be discontinued. Acquisitions in business areas other than the main area of the acquirer can be considered complements and are therefore less likely to be discontinued.

Gautier and Lamesch propose such a classification. They analyse GAFAM firms as multi-sided platforms, via which different users groups interact with each other and exchange digital content, products, information and money (Gautier and Lamesch (2021)). For instance, Amazon operates an e-commerce platforms which allows consumers to buy different products online from merchants that offer their products on this platform. The other 4 GAFAM companies also operate multi-sided platforms, but with different user groups interacting through them. Gautier and Lamesch (2021) identify six different user segments, five of which gravitate around platforms such as the ones operated by GAFAM. They also attribute target user segments to the acquired entities. In the framework of their paper, Gautier and Lamesch assign user segments to the GAFAM by using 10-K[7] reports that are publicly available and re-

[7] U.S. Securities and Exchange Commission (nd)

ported by GAFAM themselves. They give good insight into activities and the products offered by the big tech giants (Gautier and Lamesch (2021)). 10-K reports are detailed reports that show the financial performance of a publicly traded company. The U.S. Securities and Exchange Commission (SEC) mandates that companies file these reports to inform investors of the company's condition before they buy or sell shares (Kenton (2022a)). Since the paper analyses merger and acquisition activities of GAFAM from 2015 to 2017, they choose the year 2014 as a benchmark to identify the portfolio of user segments for each of GAFAM (Gautier and Lamesch (2021)). In these 10-K filings from 2014, the authors look for the breakdown of annual net sales or revenues by product category for each of the five big tech companies. By doing so, they can match the proportion of annual net sales/revenues for each product category with one of the five different user groups they defined.

Yet, Gautier and Lamesch (2021) distinguish companies on the basis of their targeted user group and not on the basis of their area of economic activity. Hence, this approach cannot answer the above research questions on overlapping economic activities as well as on cloud infrastructure. This adds to the relevance of this study as a different categorization is used to solve this problem. Argentesi et al. (2021) propose a classification that is similar to the classification made by Gautier and Lamesch, but unlike the user groups, it allows to examine the role of specific areas such as cloud infrastructure, which is increasingly important for an incumbent to support its dominant position. Furthermore, it allows to investigate the role of substitutes and complements. The following clusters are used by Argentesi et al. (2021) in their paper "Merger Policy In Digital markets: An Ex Post Assessment":

- **Communication apps and tools (CAT):** Companies active in the supply of platforms that create or simplify ways of interaction between individuals and/or within organizations. Such ways of interaction include direct communication, such as messaging and emailing, and sharing of content and personal information
- **Tools for developers (TD):** Companies that provide tools and solutions for software developers to create and optimize their digital products. This excludes products and services supplied to final consumers
- **Physical goods and services (PGS)**: Companies that manufacture, distribute, or sell physical goods of any kind or facilitate through services and software such activities, including price comparison websites, marketplaces, and online retailers
- **Digital content (DC):** Companies that deliver, create, or facilitate the fruition of digital content such as movies, games, digital text, and other digital media
- **Remote storage and file transfer (RS):** Companies that provide file storage, cloud, file sharing, and related services
- **Advertising tools and platforms (ATP):** Companies active in the advertising industry as provider of advertising content, advertising platforms or active as intermediaries between advertisers and consumers or advertisers and suppliers
- **Artificial intelligence, data science, and analytics (AI):** Companies active in the creation, distribution or enhancement of self-learning software, image, speech or text recognition software, virtual assistants, analytics, and machine learning services for big data
- **Home, well-being, and other personal needs (HW):** Companies active in the provision of software and applications designed to simplify and/or improve experience for different aspects of daily life such as: transportation, health, learning, entertainment, well-being, and home automation
- **Other (O):** Companies that cannot be clearly assigned to one of the above clusters.

The strongest argument for using clusters instead of user groups, however is the fact that the area of economic activity, which is captured by the cluster, serves as ”a proxy for actual or potential substitutability” (Argentesi et al. (2021)). According to Cunningham et al. (2021), acquired companies are more likely to be discontinued in the pharmaceutical sector, if the drugs produced by the acquired are substitutes for the drugs produced by the incumbent. This is especially true when the incumbent produces drugs that grant it a dominant position in the pharmaceutical sector. It is assumed that acquired companies operating in the same cluster as the main cluster of a GAFAM member, i.e. in the cluster with the highest annual revenues, are more likely to be discontinued after the acquisition.

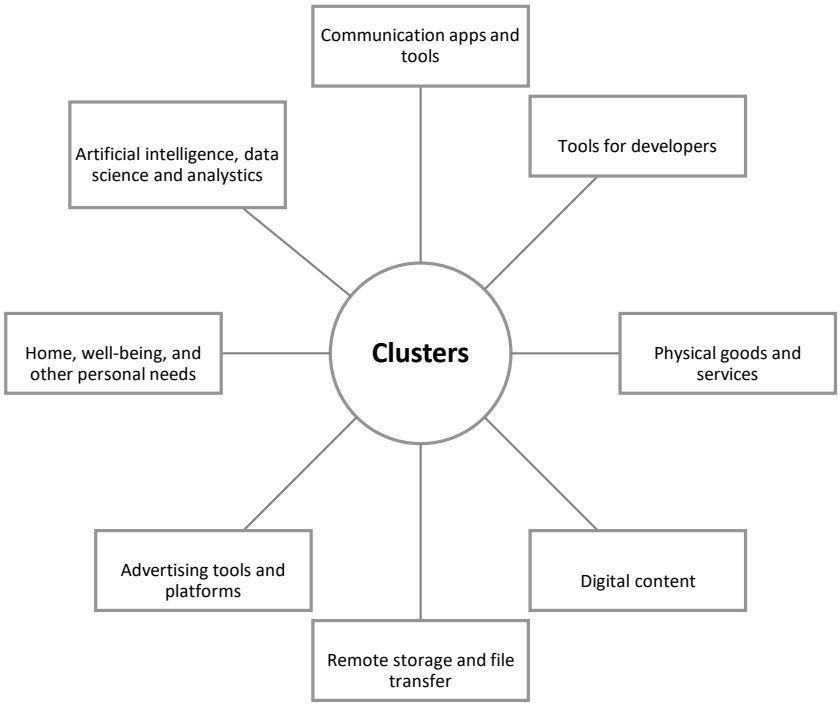

Figure 1: Clusters
Source: Argentesi et al. (2021)

In the context of this work, the clusters defined by Argentesi et al. (2021), which stand for different areas of economic activity, are used, but the method of Gautier and Lamesch (2021) for searching and defining core business areas is retained. By searching the 10-K filings of GAFAM for the breakdown of annual revenues or net sales by product category, the main clusters can be determined in a similar way than the user groups. The clusters are determined by matching the descriptions of the revenue or net sales streams with the corresponding areas of economic activity. For the individual acquired and merged companies, the description of the activities of *Crunchbase* is matched with the descriptions of the clusters to assign a cluster. Figure 1 shows schematically the clusters which Argentesi et al. (2021) defined in order to classify companies acquired by GAFAM by their area of economic activity. The allocation of clusters to GAFAM and to the companies they acquire is not always 100% accurate, as the 10-K filings do not contain a detailed, but only a global breakdown of revenues. This is also due to the descriptions of *Crunchbase*, which give limited insight into the activities of a company. It is important to note that GAFAM operate multi-sided platforms and that they generate revenues or net sales in different areas of economic activity. Compared to their merged or acquired companies, those are only

assigned to a single cluster, as this would otherwise go beyond the scope of this thesis. Given new data collected ties in with the year 2018 and ranges until 2021, it is preferable to make sure that the main income source in terms of clusters does not change over time. For this reason, the years 2014, 2017 and, 2020 are taken as benchmarks to cover to the full length of the time period analysed. The year 2014 covers the first part of the data until 2016, the year 2017 covers the second part of the data until 2019 and the year 2020 covers the third part of the data until 2021.

In the subsequent part of this work, the main clusters, which generate the largest part of the annual revenues, are determined for each big tech giant. Additionally, the active clusters, i.e. the areas of economic activity in which GAFAM operate, are precisely determined.

2.2.3 Revenue sources of GAFAM

After choosing a classification of companies by economic activity, the main sources of income still need to be identified so that the research question can be answered in terms of overlapping economic activities of the acquirer and the acquired company. Appendices 13 to 17 analyse GAFAM's revenue sources in relation to the clusters defined by Argentesi et al. (2021). For each of the 5 tech giants, the 10-K filings of 2014, 2017 and 2020 are searched and the reported annual revenues or net sales are grouped into clusters. The cluster that generates more than two thirds (67%) of the annual revenue is referred to as the "main cluster". This part of the work is essential for the later policy recommendation, since analysing the revenue sources allows policy makers to find the motivations for the mergers and how the acquired entity can generate value for the acquirer (Argentesi et al. (2021)).

In the framework of this paper, certain clusters are grouped together to facilitate the assignment of the revenue sources of the 10-K filings to the various clusters. The digital content cluster, the home, well-being and other personal needs cluster, and the tools for developers cluster are grouped together as they relate either directly to digital content and applications or indirectly to tools that enable the creation of digital content or applications. The group cluster created is therefore referred to as the digital cluster for the sake of simplicity.

Another group cluster that is formed is composed of the remote storage and file transfer cluster, the artificial intelligence, data science, and analytics cluster, and the "Other" cluster. This second group cluster is referred to as cloud infrastructure cluster. This grouping of clusters is done to capture the feature that analysed companies have important activities in "cloud infrastructure" (Moss et al. (2021)). The authors note that the "digital business ecosystems (DBE)" operated by e.g. GAFAM are increasingly focused on developing activities in the fields of artificial intelligence, data analytics, and cloud computing. Digital business ecosystems therefore acquire more and more companies active in theses fields. Between 2013 and 2020, the number of cloud infrastructure acquisitions increases on average by about 26 per cent per year, according to Moss et al. (2021). The reason behind is to obtain the technology to gather, concentrate, and to exploit the huge amounts of data collected. With this technology, the tech giants can increase economies of scale in cloud infrastructure which makes gathering and processing data more cost-effective (Moss et al. (2021)). In that way, they can create value by reaching new markets and promoting the development of the DBE. This then helps them to reinforce their dominant market positions and to potentially leverage this position to other markets (Moss et al. (2021)).

In addition, the reason for this aggregation is that GAFAM do not report the exact amounts of revenues generated by those precise clusters. Cluster grouping helps to minimise cluster assignment error, as revenues and net sales are not necessarily reported in terms of areas of economic activity. The error

minimisation also applies to the assignment of clusters to merged or acquired companies based on the descriptions of the activities in *Crunchbase*. For certain companies, it is not straightforward to allocate a particular cluster based on their *Crunchbase* descriptions. By grouping clusters and then assigning the group cluster, one gains security. Especially for companies that are active in cloud computing, it is difficult to judge from the *Crunchbase* descriptions whether the company is active in the artificial intelligence, data science and analytics cluster or in the remote storage and file transfer cluster. Both components are part of the cloud infrastructure. The clusters and group clusters used in this study and their components are listed in table 2.

Cluster / Group cluster	**Component(s)**
Digital	Digital content Home, well-being, and other personal needs Tools for developers
Cloud Infrastructure	Remote storage and file transfer Artificial intelligence, data science, and analytics Other
Physical goods and services	Physical goods and services
Communication apps and tools	Communication apps and tools
Advertising tools and platforms	Advertising tools and platforms

Table 2: Grouping of the clusters defined by Argentesi et al. (2021)

Before starting the analysis of the revenue sources of individual GAFAM members, it is important to distinguish between active and main clusters. Main cluster denotes the cluster that generates more than two thirds (%67) of the annual revenues of a GAFAM member. Active cluster denotes a cluster in which the GAFAM member is active, except if it is the main cluster. If any of the GAFAM develops a speech recognition software, for instance, then the artificial intelligence, data science, and analytics cluster is assigned as an active cluster and therefore the cloud infrastructure group cluster is assigned as an active cluster. However, one can be active in that cluster, but the cluster does not generate revenue streams, because the speech recognition software is integrated in a platform, e.g. an operating system. Then, the active cluster will not appear as a revenue source. However, thanks to online research, it can be checked whether the GAFAM member has activities in a cluster that does not generate revenues. If this is the case, then this cluster appears as an active cluster. In any case, a cluster that generates income according to the 10-K filings is an active cluster, except for the main cluster. Also, for the subsequent regression analysis and the dummy variable creations, the main clusters are not considered as active clusters.

Furthermore, it is necessary to explain that Amazon and Apple refer to ”net sales” in the income statements of the 10-K filings, whereas Meta, Alphabet, and Microsoft rather use the terms ”revenues”. ”Revenue is the income a company generates before any expenses are subtracted from the calculation” (Ross (2021)). ”Net sales is the result of gross sales minus returns, allowances, and discounts” (Kenton (2022b)). Both represent income generated from the core business operations, but net sales represent the actual performance of the product, whereas revenues can give a blurred view, as they can be distorted by non-recurring revenues. Below are the sources of income of the five big tech companies analysed one by one:

A) Amazon

Figure 2 shows the net sales of Amazon for the years 2014, 2017, and 2020. According to the 10-K filings, Amazon generates net sales in 4 different clusters. The main cluster comprises the net sales of physical goods and services. This cluster accounts for more than 67% of the annual net sales of Amazon in the years 2014, 2017, and 2020 (See appendix 13). Most of the economic activity of Amazon is the online (”amazon.com”, ”amazon.de” etc.) and physical stores (e.g. Whole Foods Market). Moreover, Amazon has an online marketplace where third-party vendors can sell their products (Ang (2020)). Amazon receives a commission for each order placed and also charges for the shipping fees.

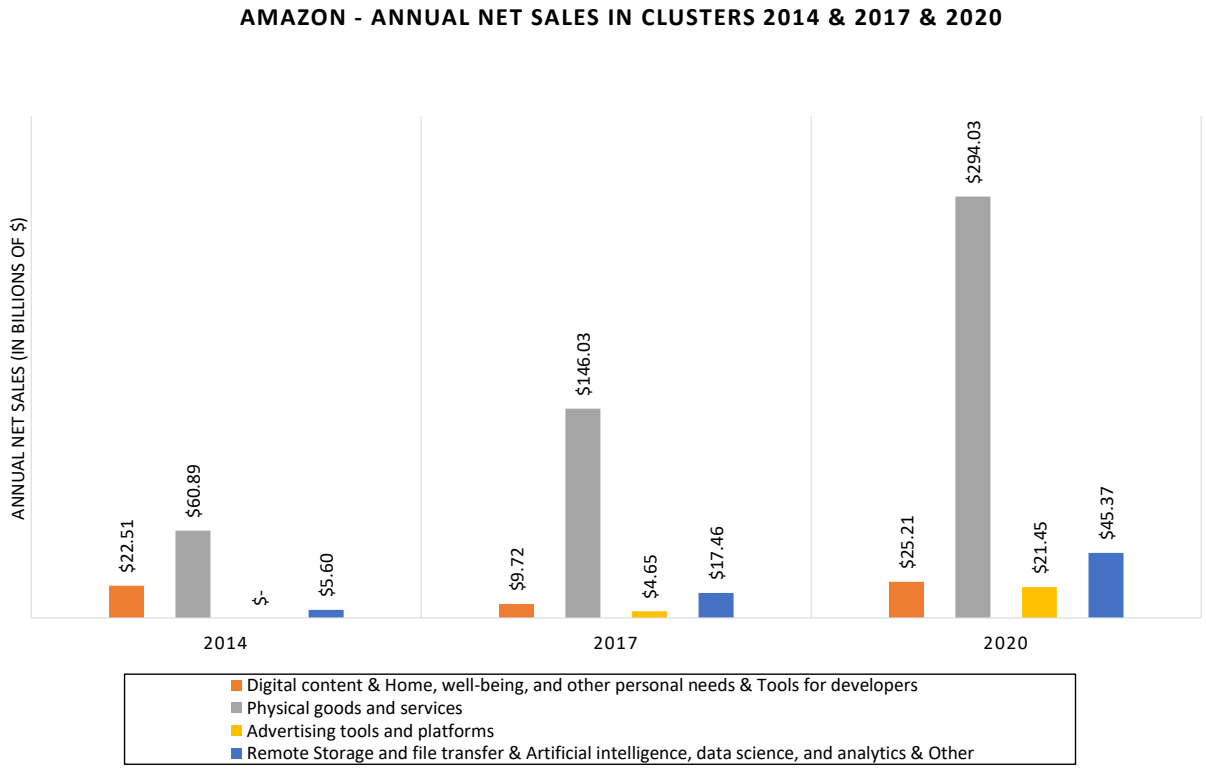

Figure 2: Annual Net Sales of Amazon
Source: Appendix 13

Based on figure 2, three revenue generating active clusters can be identified. The digital group cluster mainly accounts for the sales of subscription services linked to the Prime Membership and the sales of e-books, audio books, digital videos, and digital music. The advertising tools and platforms cluster accounts for the net sales of certain advertising services and for credit card agreements. For this cluster, no figures are disclosed in the 10-K filings of 2014. This shows that the way the figures are disclosed has changed between 2014 and 2017, with more details about advertising revenues available in 2017. The cloud infrastructure group cluster is linked to Amazon Web Services (AWS) which targets businesses. It consists of cloud-based services, such as cloud storing, but also of analytics and AI (Ang (2020)). Moreover, Amazon is active in the communication apps and tools cluster, which does not appear in the breakdown of net sales in the 10-K filings. By producing and selling ”Fire” tablets, ”Kindle” e-readers, ”Fire” TVs and ”Alexa” smart speakers with in-house operating systems, the tech giant is active in the aforementioned cluster. Figure 2 shows that the main cluster is experiencing the strongest growth,

with net sales almost doubling in 3 years, with more than $294 billion in 2020. At the same time, net sales generated by the cloud infrastructure group cluster are also increasing rapidly, becoming the second most important source of net sales for Amazon in 2020.

B) Apple

Figure 3 shows Apple's annual net sales per product for 2014, 2017 and 2020, but reported in clusters. The income structure is just as dense as for Amazon. More than 67% of annual net sales are generated by a single cluster and this for all analyzed years in sequence (See appendix 14). In this case, the main cluster is the communication apps and tools cluster. The main products of Apple are its devices, the iPads, iPhones, and Mac Computers (Wallach (2020)). Theses devices are equipped with its in-house operating system and enable individuals to interact with each other or with organizations.

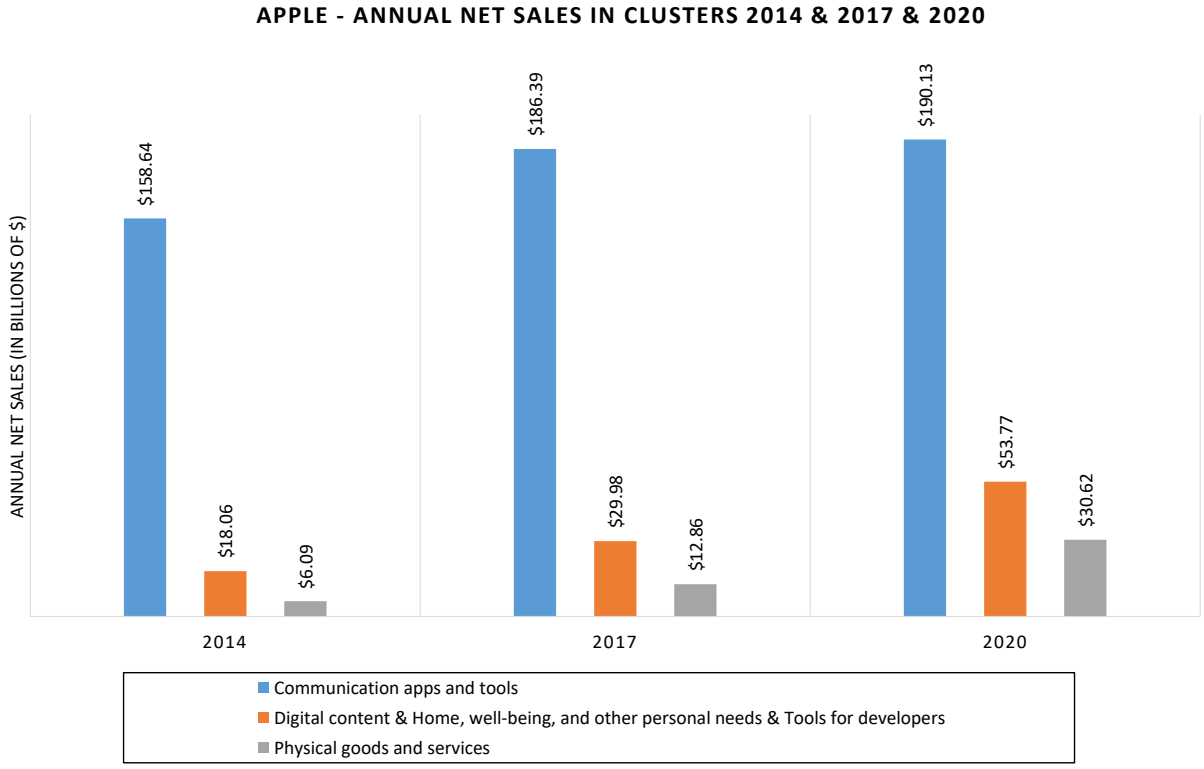

Figure 3: Annual Net Sales of Apple
Source: Appendix 14

For the active clusters, Apple distinguishes between the digital group cluster and physical goods and services, which generate the remaining part of its annual net sales. The digital content sold consists of applications and music. It also takes into account subscriptions to services like Apple Music, Apple Arcade, Apple TV+. It consists as well of services such as AppleCare and Apple Pay, which belong to the home, well being, and other personal needs cluster (Wallach (2020)). Also, Apple provides tools to app and game developers that facilitate the creation of games and apps for devices running on iOS and MacOs. The physical goods and services cluster comprises the sales of devices and accessories that complement the devices, for instance the wearable (Apple Watch) and the Air Pods. It can also be concluded that Apple is active in the cloud infrastructure group cluster, since the devices produced by

Apple are equipped with the ”Siri” virtual assistant and with the ”iCloud” cloud services. Consistent with the paper by Gautier and Lamesch (2021), only the advertising tools and platforms feature is not present in this breakdown of annual net sales. The purpose of Apple’s devices is not to provide a platform where advertisers can reach consumers.

C) Meta

Figure 4 shows the income breakdown of the smallest member of GAFAM in terms of annual revenue streams. At first sight, the advertising tools and platforms cluster stands out as the most important one. The area of economic activity that is targeted by the cluster consists of Meta’s advertising network ”Audience Network” and of ”Atlas” and ”Live Retail” (Gautier and Lamesch (2021)). Only a minor part of the income of Meta originates from the digital content and home, well being, and other personal needs clusters which consist for instance of games that are available to users of the Facebook social network. The advertising tools and platforms cluster is the main cluster with more than 90% of annual revenues originating from it for the analysed years (See appendix 15). Advertising on its social media platform generates the largest fraction of the income (Wallach (2020)). This is true for the year 2014, 2017 and 2020 since the income structure remains unchanged according to the yearly 10-K filings.

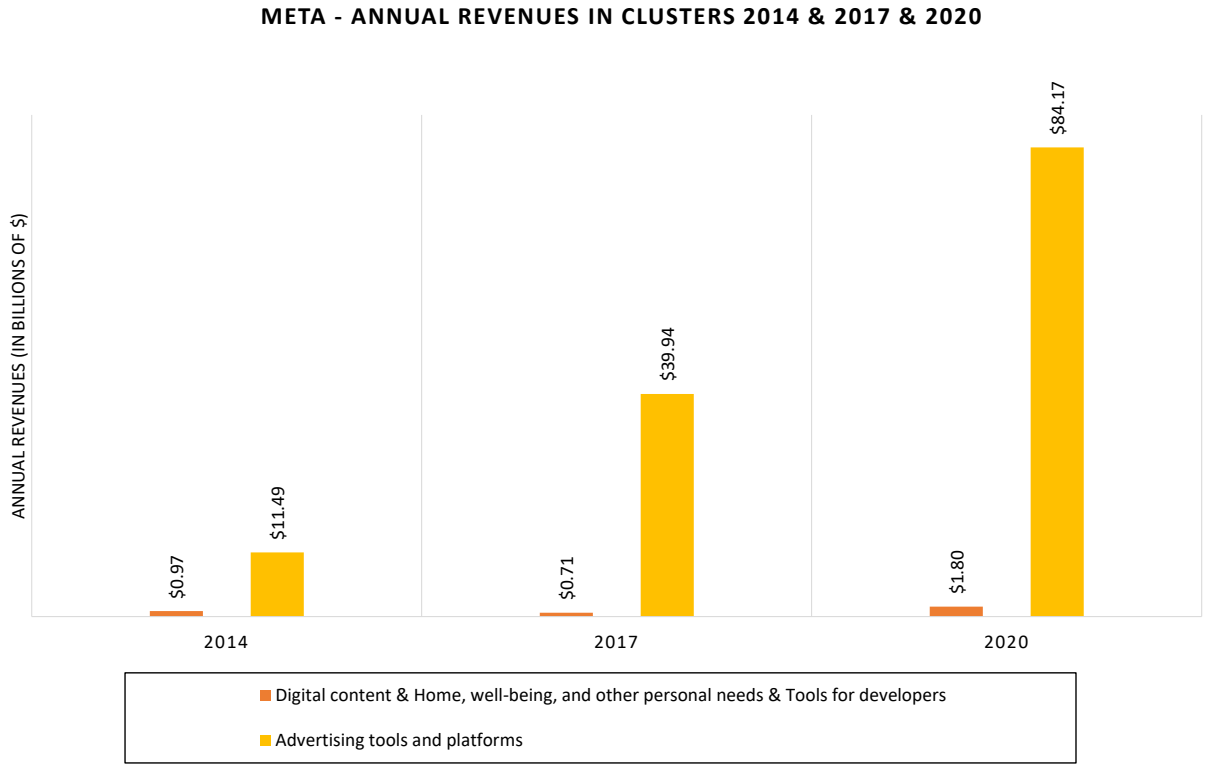

Figure 4: Annual Revenues of Meta
Source: Appendix 15

Apart from the two latter clusters, Meta is active in the communication apps and tools cluster. It is most famous for its social networks, such as ”Facebook” and ”Instagram”. Moreover, Meta is active in the cloud infrastructure group cluster. By developing algorithms and handling Big Data, Meta can provide personalized recommendations, reminders, and ads to the user base of its platforms.

D) Alphabet

Much like Meta, the main source of revenue of Alphabet is the cluster of advertising tools and platforms. In appendix 16, the income from advertising amounted to more than 80% for the years 2014, 2017, and 2020. The advertising made on the level of the Google search engine represents the most important part of Alphabet's annual revenues (See figure 5). This primary cluster remains unchanged over this period of time. By doing search engine advertising through "Ad Words", Alphabet generates revenues by selling keywords to companies, so that they are found more easily by users of the search engine. Apart from the search engine, a fraction of the advertising revenues comes from the online video platform "Youtube". Also, Alphabet operates the "Ad Sense" advertising network which generates a fraction of the advertising revenues. The latter cluster can be considered as the main cluster of Alphabet, given the importance of advertising in the revenue of scheme (Wallach (2020)).

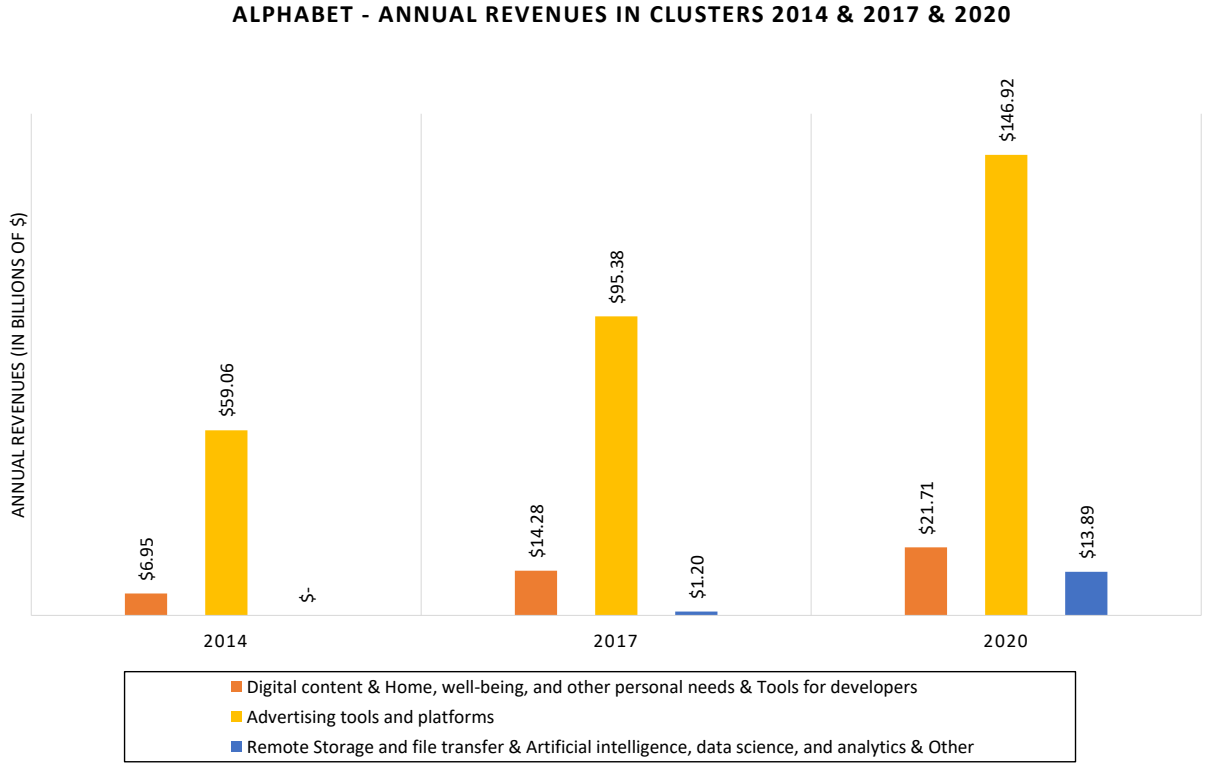

Figure 5: Annual Revenues of Alphabet
Source: Appendix 16

The rest of the annual revenues of Alphabet is generated by two active clusters. The digital group cluster consists of Youtube Premium subscriptions and the sales of apps, games, videos, books, and music through the PlayStore on Android devices. This cluster is also ensured by Alphabet's applications and wearables that are used in the field of health (Google Fit and Fitbit). It is ensured through Alphabet's numerous developer tools, such as "Chrome Dev Tools" which is a set of authoring and debugging tools built into Google Chrome. The second one is the cloud infrastructure group cluster that accounts for the virtual assistants installed on Android devices and for the AI based products that Google is developing, for instance self-driving cars (Wallach (2020)). It also accounts for remote storage and file transfer via Alphabet's "Google Drive" cloud services. From 2014 to 2017, Alphabet changed the way of disclosing

annual revenues in the income statements of the 10-K filings. For this reason, no figures are available for 2014 for the cloud infrastructure group cluster. Alphabet is also active in communications applications and tools, but this does not contribute to its annual revenues, according to the 10-K filings. Alphabet develops an operating system for a range of devices such as smartphones, tablets, and smart watches.

E) Microsoft

Appendix 17 shows the income structure on the last tech giant in the list. The income structure is more diversified than those of its counter-parties. However, none of the revenue generating clusters reaches the 67% of annual revenues to be considered as the main cluster. A major cluster that generates a significant part of Microsoft's annual revenues is the communication apps and tools cluster (See 6). Microsoft's operating system Windows 10 for personal computers and Windows phones constitute the main components of this cluster. Also, revenues from Microsoft's social network LinkedIn and from the Xbox game console are contained in this cluster. The group cluster for cloud infrastructure also represents a major revenue source for the tech giant. The main component of this cluster is "Azure", the cloud-computing platform of Microsoft. (Wallach (2020)). As per 6, the communication apps and tools cluster and the cloud infrastructure group cluster constitute the two main clusters of Microsoft amounting to 33% and 31% of annual revenues in 2020. These two clusters are retained as the main clusters.

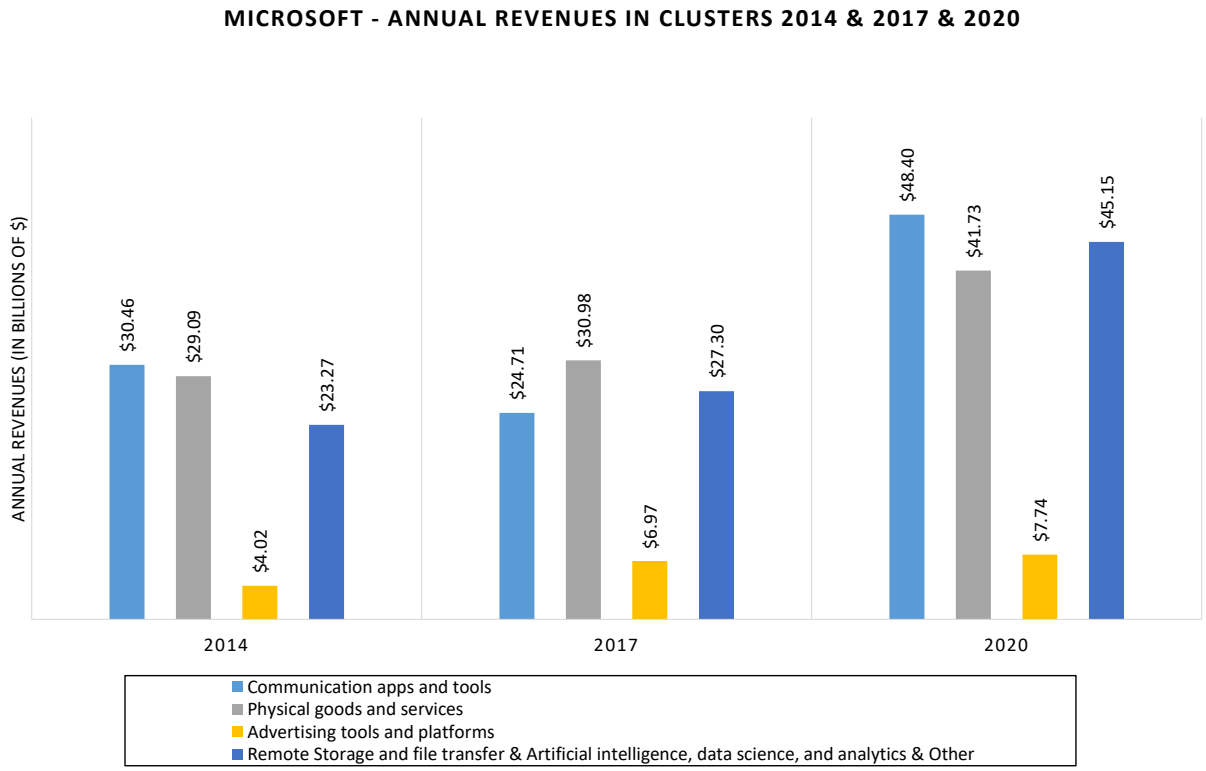

Figure 6: Annual Revenues of Microsoft
Source: Appendix 17

Furthermore, Microsoft generates revenues in two active clusters, the physical goods and services cluster and the advertising tools and platforms cluster. The first one accounts for Microsoft office

products and related cloud services for enterprises. The second revenue stream is generated by search advertising on the ”Bing” search engine of Microsoft. This revenue stream is not nearly as essential as they are at Alphabet, which also operates a search engine. Finally, Microsoft is active in digital content and living, well-being, and other personal needs. Microsoft owns several game development studios that develop games for video consoles and personal computers. Also, Microsoft releases developer tools for content and game creators and who can offer their created content and games through the Microsoft store. This cluster does not appear in the 10-K filings as a distinct revenue source, so it is assumed to be integrated into one of the other clusters.

G) GAFAM

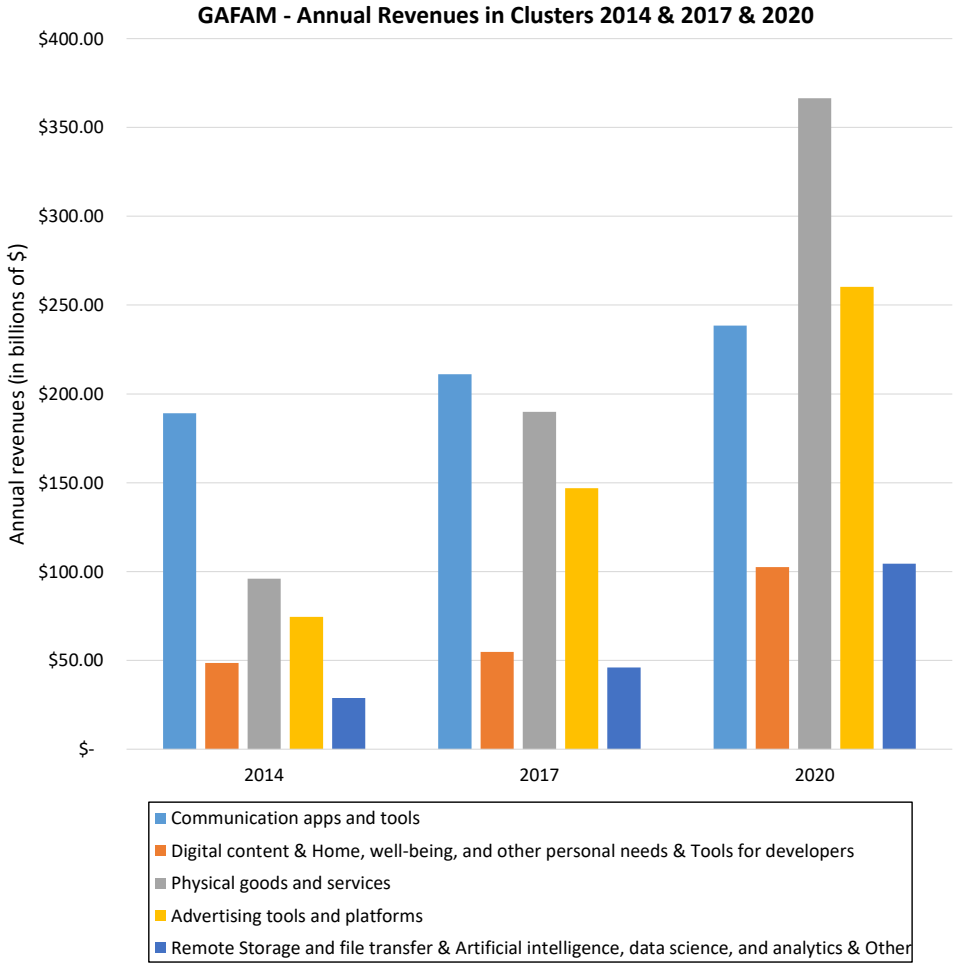

Figure 7: Annual Revenues of GAFAM
Source: Appendices 13 to 17

Figure 7 displays the annual GAFAM revenues per cluster for the years 2014, 2017 and 2020. Even though Amazon and Apple report annual net sales instead of annual revenues in the 10-K filings, the revenues and net sales are combined in one figure to represent the evolution of income sources of GAFAM. The physical goods and services cluster experiences the strongest growth, attaining over 350 billion dollars in 2020. This is mostly due to the increasing revenues from Amazon’s online and physical

stores. As shown in 7, annual revenue in the cloud infrastructure group cluster tripled from 2014 to 2020. This might be evidence for the increasing role of data. In fact, this group cluster accounts for the concept of cloud infrastructure and is related to collecting, storing, and processing of big data sets. Furthermore, the figure shows that revenues from the advertising tools and platforms cluster also grow sharply between 2014 and 2020. This correlation suggests that digital business ecosystems are not only increasing their activities in cloud infrastructure, but are also already monetising their economies of scale in data operations that are used to identify consumer preferences. This valuable information is then sold to advertisers to make personalised and targeted ads.

Table 3 provides an overview of the composition of GAFAM's main annual sources of revenue. Amazon and Microsoft are active in each of the 5 clusters. Alphabet and Apple are active in almost all areas of economic activity, with the exception of physical goods and services and advertising tools and platforms, respectively. Meta is the smallest of the 5 tech giants and is not active in the physical goods and services cluster. Microsoft is a special case as it is the only tech giant that is assigned to two main clusters as the revenue structure is much more diversified.

Cluster	**Amazon**	**Apple**	**Meta**	**Alphabet**	**Microsoft**
Communication apps and tools	✓	✓	✓	✓	✓
Digital content & Home, well-being, and other personal needs	✓	✓	✓	✓	✓
Physical goods and services	✓	✓			✓
Advertising tools and platforms	✓		✓	✓	✓
Remote Storage and file transfer & Artificial intelligence, data science, and analytics & Tools for developers & Other	✓	✓	✓	✓	✓

Table 3: Overview of active and main clusters of GAFAM
Source: 10-K filings & Own research

The idea of this section is to identify the money side for each of the major tech giants, i.e. the main area of economic activity. After assigning clusters to the acquired companies, acquisitions in the acquirer's main cluster can be examined. These acquisitions, considered as substitutes for the acquirer's main cluster, are more likely to be discontinued after the acquisition, based on the paper by (Cunningham et al. (2021)). Acquisitions in one of the active clusters of the GAFAM can be regarded as complements and may be less prone to post acquisition shutdowns. Now that the main and active clusters of GAFAM are identified thanks to the 10-K filings, it is essential to analyse their transaction histories over the past few years. The following part deals with the descriptive statistics on these past transactions and explores features of acquired companies that are related to the research questions, such as the age, the total funding, and the origin. The descriptive statistics part also includes the aspect of the previously defined clusters. These clusters are relevant to answering the research questions about the role of overlapping economic activities and cloud infrastructure.

2.3 Overview of past transactions

The aim of the literature review and the methodology section is to lay the foundation for the empirical part of the thesis. On the one hand, the aim was to obtain the necessary theoretical knowledge regarding mergers and acquisitions in the digital economy. On the other hand, it was a matter of identifying the areas of economic activity and main income streams of GAFAM in order to place them into the context of the strategies. Subsequently, the first stage of the empirical part examines GAFAM's M&A transaction histories between 2015 and 2021. The purpose of this is to gain insight into the strategies of GAFAM, especially with regard to age, data, overlapping economic activities, total funding, and the origin of the acquired entities. These relevant factors help to answer the research questions, which specifically aim to reveal the role of these factors in the M&A strategies and for the market power of the tech giants. Also, this insight prepares the ground for the M&A discontinuation analysis, which is the the second stage of the empirical part.

This section discusses the descriptive statistics of the 329 mergers and acquisitions identified for the period from 2015 to 2021. For this study, the history of GAFAM's merger activities from 2018 to 2021 was researched on *Wikipedia* and on the *Microsoft* website and then entered into *Crunchbase*. All relevant information was taken from there and compiled into a database. The collected data was then combined with the data from Gautier and Lamesch (2021). In total, 329 acquisitions have been recorded for GAFAM between 2015 and 2021. From figure 8, it can be seen that Alphabet and Microsoft are the two big tech companies that are involved in the most mergers and acquisitions from 2015 to 2021 with 82 and 93 acquisitions, respectively. Appendix 8 shows a detailed view of the number of acquisitions per acquirer and per year. Apple made 60 acquisitions during that period and Amazon 50 acquisitions. Meta has the lowest number of acquisitions with a total of 44 acquisitions made during the analysed period of time. Alphabet made the most purchases in the period from 2015 to 2017 and was overtaken by Microsoft from 2018 onwards. In general, the number of annual acquisitions declines from 65 in 2015, the maximum annual number of acquisitions over the period studied, to 31 acquisitions in 2021. In 2020, worldwide M&A deal activity decreased sharply with the occurrence of the COVID-19 pandemic in March 2020 (Harroch (2020)). The pandemic, which has been ongoing since March 2020, causes serious economic consequences. Therefore, a correlation between the decline in economic growth due to the pandemic and the decline in mergers and acquisitions from 2020 onwards can be observed.

(a) Origin of Target Firms					
Region	US	Non-US	Unknown		
No. of Obs.	214	104	9		
(b) Age and funding					
	Min	Median	Mean	Max	NA's
Age of the acquired firm	0	5	7,00	97	5
Amount (in million US$)	0,015	9,50	43,90	1.000,00	112

Table 4: Descriptive statistics
Source: Gautier and Lamesch (2021) and own research based on Crunchbase data

Table 4 contains descriptive statistics for the created database (see also appendix 9 for more detailed statistics on age and funding). The merged or acquired companies are mainly from the United States and account for almost two thirds of the 329 observations (See point (a) of table 4). 104 observations come from outside the United States and mostly from European countries and for 9 observations the origin could not be determined.

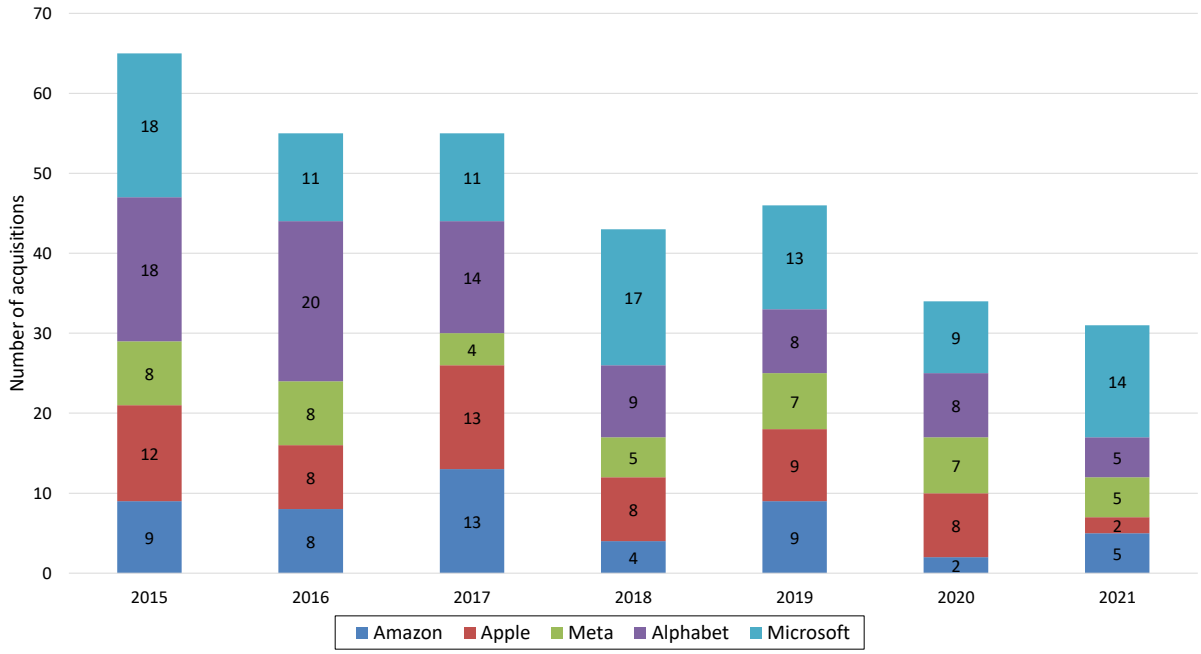

Figure 8: Number of acquisitions of GAFAM between 2015 and 2021 Source: Gautier and Lamesch (2021) and own research based on Crunchbase data

As per panel (b) of table 4, the median age of acquired or merged companies is 5, meaning that half of them is younger than 5 years and half of them is older than 5 years. This finding highlights the fact that M&A activities often target young firms rather than experienced ones. In appendix 9, the average age of acquired companies between 2018 and 2021 is displayed for each big tech giant individually. For Amazon and Microsoft, the average age is well above the average age of the sample. The reason for this is that they acquired a series of companies that were founded before 2000. Amazon and Microsoft therefore have acquisition strategies that tend to be directed towards well-established companies. This confirms the findings of Argentesi et al. (2021), who use data on publicly announced acquisitions by Amazon, Meta, and Alphabet for the years 2008 to 2018. The acquisition strategy of Meta is more oriented towards young start-ups. The average age of the companies acquired by Meta is 4.72 years, considerably lower than the sample average of 7 years. None of the acquired companies was founded before the year 2000. The strategies of Apple and Alphabet can be considered as mixed, as they acquire a mix of well-established and young companies, but with a preference for younger companies.

In terms of funding amounts, the conclusion is the same. The average company raised an amount of $9.5 million before being acquired by one of the GAFAM. This is consistent with the findings of Gautier and Lamesch (2021) that acquired companies are in most cases still in their infancy at the time of acquisition, although funding amounts tend to increase with the additional data for 2018-2021. Also, the maximum amount is $1 billion for 2015 to 2021, compared to $460 million for 2015 to 2017. Information on total funding was not available for all 329 observations, therefore this statement refers to the 217 observations for which such information is available. The companies acquired by Amazon and Apple raised the highest amount of funding prior to their acquisition, averaging $61 million (See appendix 9). The higher average funding amounts confirm the previous statement that Amazon prefers well-established

companies and Apple too, to some extent. Together with the observation that the number of annual acquisitions and mergers falls from 2015 to 2021, it can be suggested that capital raised by companies before being acquired by GAFAM increases. However, this could also indicate the company in question has a promising business concept and can potentially become a serious competitor in the future and therefore may be more prone to killer mergers.

The next step is to examine the aspect of areas of economic activity. After assigning clusters to each of the acquired companies, the following figure 9 can be obtained for GAFAM for the analysed period of time. This figure shows the distribution of GAFAM transactions across clusters. The two previously defined group clusters are also represented in this figure. The detailed number of acquisitions per acquirer and per cluster can be found in appendix 12. Acquisitions that could not be directly assigned to a cluster are assigned to the ”Other” cluster.

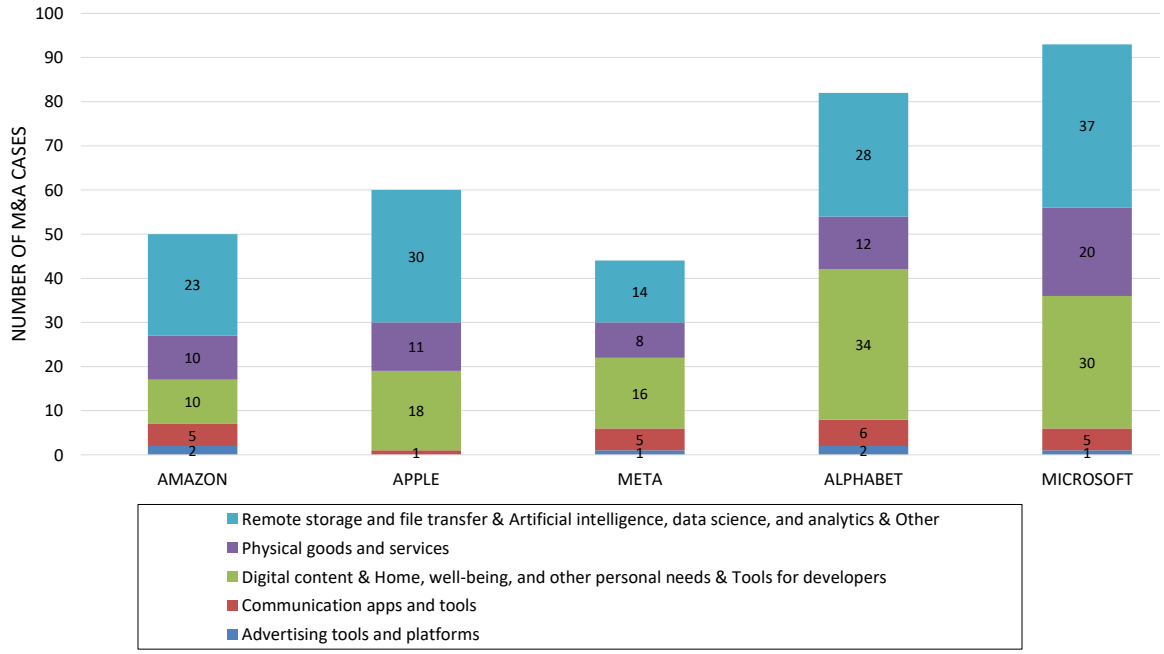

Figure 9: Number of acquisitions of GAFAM per cluster
Source: Gautier and Lamesch (2021) and own research based on Crunchbase data

Thereafter, the number of different clusters of the acquired or merged companies is shown graphically in figure 9. Appendix 10 shows the same figure, but with clusters not grouped together. All GAFAM members made the highest or the second highest number of acquisitions in the cloud infrastructure group cluster for the period from 2015 to 2021. This highlights the importance of this cloud infrastructure group cluster for operating and improving multi-sided platforms, but also for their future strategies. Nevertheless, it is first a matter of understanding the AI cluster, the largest component in this group cluster and how it relates to the M&A strategies. For Amazon, artificial intelligence, data science and analytics contribute to the improvement of Amazon’s virtual assistant ’Alexa’. It also helps the tech giant to expand its cloud computing business ”AWS” and to enhance the search algorithm of the online retail platforms. Furthermore, Amazon can be expected to stay active in the field of self-driving cars, as the company acquired Zoox in 2020, which had raised $1 billion in funding by then (Tazrout (2021)).

For Apple, it contributes to the operating systems for its iPhones, iPads, and Mac computers. Apple is less focused on cloud computing and more on computing on its own devices (Tazrout (2021)). Apple is also working to improve its voice assistant "Siri" by acquiring companies involved in the development of voice recognition, voice assistants, and voice technology. Also for Meta, the AI cluster serves as a support for the social network "Facebook" by improving data analytics and therefore, advertisers can target customers more precisely. Moreover, Meta is working to create the Metaverse, a three-dimensional virtual space that can be entered using VR (virtual reality) technology to interact with other people. For this purpose, Meta acquirers companies active in this cluster (Tazrout (2021)). Alphabet makes acquisitions in the AI cluster in order to further improve its search engine and Android operating system, but also for applications such as VR. Microsoft is the tech giant with the highest number of acquisitions in this cluster, which is also one of its main clusters, with a total of 48 M&A cases. The aim is to develop in the field of cloud computing to improve "Microsoft Azure" and Windows operating systems for personal computers to better serve businesses (Tazrout (2021)). This evidence underlines the intuition obtained from the review of the 10-K filings. Tech giants seem increasingly interested in improving their cloud infrastructure activities and data operations by acquiring relevant companies. This therefore improves their ability to make predictions, identify user preferences for the development of products and services, and monetise data through advertising.

The second most important cluster is the digital group cluster. By acquiring companies that offer digital content, applications for the home, well-being and other personal needs, as well as tools for developers, GAFAM aims to attract the attention of users and make their platforms more attractive (Gautier and Lamesch (2021)). With more users on their platforms, GAFAM can therefore collect more data and explore the preferences of their users. This information can then be monetised through advertisers. Overall, the importance of the digital group cluster underlines the intuition that GAFAM might want to make better use of its cloud infrastructures.

Apart from the size of the two group clusters, it can still be seen here in figure 9 that the number of M&A cases in the main income clusters is rather low. For Apple and Microsoft, the communication apps and tools cluster represents the main cluster of the two companies, with one and five acquisitions, respectively. The same applies to Meta and Alphabet and the advertising tools and platforms cluster. Meta made one acquisition and Alphabet two acquisitions in this cluster. Amazon made comparatively more acquisitions in the main segment, with a total of ten acquisitions in the physical goods and services cluster during the analysed period of time. It can be assumed that acquisitions in the digital and cloud infrastructure group clusters complement the products and services of GAFAM. On the one hand, the artificial intelligence, data science, and analytics group cluster serves to process data, but also to make predictions to improve the multi-sided platforms and thus make them even more comprehensive. Due to the many mergers, GAFAM are able to combine their own data with that of the merged and acquired companies. The resulting volume of data, combined with the knowledge of the acquired companies to treat this data, gives GAFAM a competitive advantage (Argentesi et al. (2021)). Such data domination can further reinforce the barrier to entry into digital markets. On the other hand, with more digital content, more users will be attracted to use the platform. This is the principle of network effects. In both ways, GAFAM can further expand their dominant positions. According to Argentesi et al, GAFAM's business models are very complex and various products and services supplied by the merged or acquired companies are involved in the production process of the products and services supplied by GAFAM (Argentesi et al. (2021)).

Acquirer	Continued	Discontinued	NA	Total
Amazon	21 (42.00%)	24 (48.00%)	5 (10.00%)	50
Apple	7 (11.67%)	48 (80%)	5 (8.33%)	60
Meta	12 (27.27%)	28 (63.64%)	4 (9.09%)	44
Alphabet	33 (40.24%)	41 (50.00%)	8 (9.76%)	82
Microsoft	52 (55.91%)	36 (38.71%)	5 (5.38%)	93
Total	**125 (37.99%)**	**177 (53.80%)**	**27 (8.21%)**	**329**

Table 5: Continuation vs. Discontinuation
Source: Gautier and Lamesch (2021) and own research based on Crunchbase data

After the retrospective analysis of the acquisitions in the individual clusters, the analysis of the operating status of the individual companies is carried out. This analysis serves the purpose of finding drivers of company discontinuation decisions. Table 5 shows the number of companies that were continued or discontinued by GAFAM post acquisition between 2015 and 2021. In total, discontinuation of 177 (54%) companies and continuation of 125 (38%) are noted. The status of the company is determined with respect to the decision tree defined in section 4.4 of the appendix. In 27 (8%) cases, the status of the acquired company post acquisition can not be determined. Apple and Meta seem to be systematically shutting down companies that have been acquired with discontinuation rates of 80 % and 64%, respectively. This underlines the intuition of Gautier and Lamesch (2021) that Apple and Meta might want to keep a ”closed system” and to unify the acquired companies under one brand name. Alphabet discontinues half of the acquired companies and Amazon and Microsoft discontinue less than half of the acquired companies. For Microsoft, this seems comprehensible, since it bought a large number of companies active in the digital content segment, especially game developer studios. These studios have a certain reputation with gamers and Microsoft can unite all of them in the *Xbox* gaming group.

Operating status	ATP	AI	CAT	DC	HW	O	PGS	RS	TD	**Total**
discontinued	2 (33.33%)	62 (64.58%)	13 (59.09%)	19 (42.22%)	12 (52.17%)	10 (66.67%)	29 (47.54%)	13 (61.90%)	17 (42.50%)	177 (53.80%)
NA	0 (0.00%)	8 (8.33%)	2 (9.09%)	1 (2.22%)	1 (4.35%)	3 (20.00%)	7 (11.48%)	2 (9.52%)	3 (7.50%)	27 (8.21%)
running	4 (66.67%)	26 (27.08%)	7 (31.82%)	25 (55.56%)	10 (43.48%)	2 (13.33%)	25 (40.98%)	6 (28.57%)	20 (50.00%)	125 (37.99%)
Total	**6**	**96**	**22**	**45**	**23**	**15**	**61**	**21**	**40**	**329**

Table 6: Operating Status per Cluster
Source: Gautier and Lamesch (2021) and own research based on Crunchbase data

On the basis of table 6, a few observations can be made regarding the operating status of acquired companies after GAFAM acquisition. First, discontinuation rate is the highest in the artificial intelligence, data science, and analytics cluster. This could be an indicator that large technology companies are buying companies in this cluster so that the knowledge of handling big data and making predictions does not become a competitive advantage for an innovative startup. Or it could be that they want to prevent this knowledge from falling into the hands of a competitor through a merger or acquisition, who can then use it to gain a competitive advantage and challenge the incumbent. Second, the remote storage and file transfer cluster exhibits a high discontinuation rate of 61.90%. 13 of 21 companies were shut down. The latter cluster may be used to bolster business activities that are consolidated in one group (Argentesi et al. (2021)). For example, Amazon can integrate the acquired companies into the operation of Amazon Web Services or, at Microsoft, into the Azure cloud computing platform. Appendix 10 shows that even

at the aggregate level, the cloud infrastructure group cluster containing Artificial Intelligence, remote storage, and other has the highest discontinuation rate among the clusters, followed by communication apps and tools cluster.

After analysing GAFAM revenue sources and M&A activities retrospectively, a few points can be retained about acquisition strategies of the five big tech giants that play a role in the identification of factors promoting discontinuation of companies. The revenue streams of GAFAM are highly concentrated. For all of the big tech players, at least one main cluster can be identified which generates more than 67% of the annual revenues or net sales, except for Microsoft. The overview of main and active clusters can be found in table 3. By comparing the main clusters of the acquirer with the cluster of the acquired entity, it can be observed that GAFAM do not make the highest number of acquisitions in their main business area. However, most of the mergers and acquisitions by GAFAM are made in the cloud infrastructure group cluster, followed by the digital group cluster.

When referring to appendix 10, one can observe that among the cloud infrastructure group cluster, especially the artificial intelligence, data science, and analytics clusters stands out. For the second group cluster, digital content appears most influential. In terms of the age of the companies acquired, GAFAM seem to favour younger companies, with some exceptions of older and experienced companies. Also, based on the total funding, the same conclusion can be made that companies are still in their beginning at the moment of the acquisition. Most of the acquired entities come from the US. Furthermore, Apple and Meta seem to discontinue companies post acquisition more systematically as the other three GAFAM members. Finally, discontinuations are the highest in the artificial intelligence, data science, and analytics cluster, followed by the other and remote storage and file transfer clusters, which are the three main components of the cloud infrastructure group cluster.

Descriptive statistics were used to examine the factors of age, total funding, origin, field of activity and overlapping economic activities. The patterns observed allow limited conclusions to be drawn about GAFAM's strategies. Yet, the above factors need to be analysed in the context of their post-acquisition operating status. To this end, the subsequent regression analysis examines these factors as potential drivers of GAFAM's company shutdown decisions.

2.4 M&A Discontinuation Analysis

The second stage of the empirical part is to investigate the drivers of shutdown decisions by GAFAM. After identifying some patterns in the strategies, it remains to be examined if these factors influence the discontinuation decisions by GAFAM. The examination contributes to answering the research question of how age, data, and overlapping economic activities are related to market power of GAFAM in the context of merger and acquisition strategies. This market power might be used in an anti-competitive way. The second research question examines the role of funding and the origin of the acquired company in explaining GAFAM's market power. Therefore, the link between discontinuation decisions and funding, as well as origin of the acquired entity, is investigated. Based on the results, a potential policy recommendation is formulated that highlights relevant factors for anti-competitive behavior as alarm indicators.

A total of 329 mergers and acquisitions were identified for the period from 2015 to 2021. For the regressions, 27 observations for which the operating status can not be determined, are excluded, as well as 2 observations for which the foundation dates are not available. Hence, the sample size is reduced to 300 observations. Additionally, the analysis is restricted to the time period from 2015 to 2020 by removing all observations for the year 2021. Another 30 observations are therefore removed from the analysis. The reason for this exclusion is that the time between the end of 2021 and today is not yet long enough to be able to state with certainty that the companies acquired in 2021 have actually already received their final operating status. For example, the advertising company "Xandr", which was taken over by Microsoft in December 2021, is still in operation. However, it is not known whether this company will not be shut down in 2022. To check the robustness of the results, the same models are constructed for the period from 2015 to 2021 (See appendix 18).

The first assumption to be tested in this part of the thesis is whether younger companies are more likely to be closed after a GAFAM acquisition. Descriptive statistics on mergers and acquisitions show that the acquired companies are often still in their infancy at the time of the acquisition. The second assumption relates to overlapping activities between firms and whether firms operating in the same cluster as GAFAM's main clusters are more susceptible to being discontinued. Cunningham et al. (2021) found that acquisitions of pharmaceutical companies that have an overlapping drug portfolio with the acquirer are more likely to be discontinued post acquisition, if the drug produced by the acquired entity is a substitute for the drug produced by the acquirer. This finding is tested using the clusters defined by Argentesi et al. (2021) and using the main and active clusters of GAFAM that are defined in table 3. Third, it is particularly important to pay attention to the area of cloud infrastructure, as noted in the literature review and descriptive statistics sections. Therefore, the assumption that acquired companies operating in the cloud infrastructure field are more prone to be terminated after the acquisition is tested. Fourth, additional features of acquired entities are investigated as drivers for shutdown decisions. Theses features are the origin and the funding in millions of US dollars of the acquired companies. To investigate the drivers of company discontinuations, Probit regressions are used to take a closer look at the decisions made by GAFAM. While holding the other factors of company discontinuation constant, the probability for a company being discontinued by GAFAM after the acquisition can be written as follows:

$$P(Discon_i = 1|Age_i, A_i, X_i, Z_i) = \phi(\alpha, \beta_1 Age_i, A_i'\gamma, X_i'\delta, Z_i'\zeta) \quad (1)$$

The dependent variable $Discon_i$ is binary and monitors the post acquisition operating status of the acquired entity i. The objective is to explain what factors influence the decision of GAFAM to discontinue a company post acquisition. This dependent variable takes a value of 1 if company i was shut down after the GAFAM acquisition, with respect to the decision tree defined in section 4.4 of the appendix, and 0 if it is still running. A basic set-up is specified, based on model 1 from "Mergers in the Digital Economy" by Gautier and Lamesch (2021), to which further variables are then added. In their model, these authors use the same dependent variable and choose age, dummy variables for the acquirers, and dummy variables for the years as independent variables. In this thesis, the first model contains 10 independent variables. The independent variable Age_i controls for the age in years of company i at the time of the acquisition. The variable is computed by subtracting the year of company foundation from the year of GAFAM acquisition. The intuition established on the basis of descriptive statistics is that younger companies are more likely to be discontinued. The expected sign is therefore negative, since increasing the age of an acquired company is likely to decrease the probability of discontinuing the company.

The vector A_i' contains $Alphabet_i$, $Meta_i$, $Apple_i$ and, $Amazon_i$ that are dummy variables and that control for the different acquirers. The Microsoft dummy is selected as the base dummy and is excluded from the vector. The reason for this choice is that Microsoft is a special case. The analysis of revenue streams has shown that Microsoft has a diversified revenue structure and has been attributed two main clusters based on a personal assessment. Furthermore, Microsoft has the lowest discontinuation rate (See table 5). For Meta and for Apple, the sign is expected to be positive, since they have the highest discontinuation rates among GAFAM, which might indicate that they prefer to keep a closed system and, therefore, discontinue more systematically the companies acquired than Microsoft.

Additionally, the vector X_i' contains dummy variables for the years 2016 to 2020, where 2015 is selected as the base year, since it is the first year in the database. For model 1, vector Z_i' is equal to 0. ϕ denotes the Cumulative Density Function of the standard normal distribution. The change in probability of company discontinuation decisions by GAFAM can be estimated using a Probit regression model. The results of the basic set-up model are displayed under model 1 in table 7. The only conclusion that can be drawn from this basis set-up model is that the coefficients on Meta and Apple are significant. Both tech giants are more likely to discontinue companies post acquisition than Microsoft.

Models 2 and 3 are used to answer the research question related to cloud infrastructure. In model 2, vector Z_i' contains dummy variables for the clusters defined by Argentesi et al. (2021). To each merged or acquired company, a cluster or group cluster is allocated (See table 2). The independent variable $Digital_i$ takes for instance the value 1 if company i is active in the digital group cluster and 0 otherwise. The cloud infrastructure group cluster is controlled for by the independent variable $Cloud_i$ and is selected in this model as the base cluster. This group cluster is chosen because it is related to the cloud infrastructure research question.

This group cluster is also the most noticeable in the descriptive statistics, as most transactions were made in the area of cloud infrastructure and the discontinuation rate in the clusters it comprises is particularly high. The conclusion from the estimation of model 2 is similar to the one of Gautier and Lamesch (2021) who add user segments instead of clusters to their benchmark model. There is no systematic cluster effect in the estimations. Despite the absence of a systematic cluster effect, some findings can still be retained. The coefficient on $Communication_i$ is not significant. However, the coefficients on $Physical_i$, $Digital_i$, and $Advertising_i$ are significant. On average, acquisitions in these clusters are

less likely to be discontinued, compared to acquisitions the cloud infrastructure group cluster. However, this finding should be treated with caution, as the cloud infrastructure group cluster chosen as the base category contains three clusters. It comprises the artificial intelligence, data science and analytics cluster, the remote storage and file transfer cluster, and the other cluster. This is because of the way income is published in the 10k filings. Hence, this finding is true on the aggregate level, but it may not be the case on the individual cluster level. This means that if the individual clusters contained in the cloud infrastructure group cluster are selected as the base category, then the coefficients might not be significant. Moreover, by adding the year 2021, the results do not change, which shows the robustness of these results (See Model 2 in appendix 18). Observations for the year 2021 were excluded from the first set of Probit estimations to account for the possibility that companies acquired in 2021 may not yet have received their final operating status at the time of this thesis (As of May 2022).

To account for the role of cloud infrastructure in the discontinuation decisions of GAFAM, a dummy variable $Cloud\_Infrastructure_i$ is created. In model 3, the vector Z_i' contains the cloud infrastructure dummy. It takes the value 1 if the acquired company i is active in the field of cloud infrastructure and 0 otherwise. The coefficient is highly significant. Acquisitions in the field of cloud infrastructure increase the probability of GAFAM discontinuing them after the acquisition by 17.9% on average. The robustness check, which includes observations for the year 2021, confirms this finding (See appendix 18). This finding has a big implication for answering the research question, since the aim is to find out whether cloud infrastructure acquisitions are used by incumbents to consolidate their strong market positions. A strong market position, i.e. greater market power, may result in anti-competitive practices.

Models 4 and 7 are used to answer the research question related to overlapping economic activities. In model 4, vector Z_i' contains a dummy variable for the main revenue source. If the acquisition is made in the main income cluster of the acquirer, then the variable $Core_i$ takes the value 1 and 0 otherwise. The main clusters can be found in table 3. Microsoft is the only GAFAM member that has two main clusters. The coefficient of $Core_i$ is not significant and therefore one cannot conclude on the impact of overlapping economic activities between the acquirer and the acquired company on GAFAM shutdown decisions. The same statement is true when the year 2021 is included in the analysis. Models 5 and 6 are used to answer the research question related to funding and origin of an acquired firm. In the model 5, the variable for total funding in millions of $ is contained in vector Z_i'. 90 further observations are excluded from the Probit estimations, because no information on total funding was available for the companies in question. Hence, the sample size is reduced to 180 observations. The coefficient on $Funding\_millions_i$ is not significant. Model 6 includes a dummy variable that controls for the origin of the acquired company. For 262 companies, the origin could be determined. US_i takes the value 1 if the acquired company was founded in the United States and 0 otherwise. The coefficient is not significant. The last model controls for the active cluster of GAFAM. The vector Z_i' contains the dummy variable $Active_i$. If an acquisition is made in a cluster in which GAFAM are active but which is not their main cluster, then the variable takes the value 1. The active clusters are shown in Table 3. The coefficient on $Active_i$ is not significant. However, with the year 2021 included, the coefficient is significant on the 5% level and has a negative sign. On average, an acquired company's operation in an active cluster of one the GAFAM members decreases the probability of being shut down post acquisition by 12.3%. As a precaution, the result of the Probit estimations for the period 2015 to 2020 is taken into account.

For models 2 to 6, Probit estimations with the year 2021 included yield the same results as the probit estimations without the year 2021 (See appendix 18). To answer the research question related to the age, models 4 to 7 are used. The main result that can be retained from the latter models for the

variable Age_i is that older firms are less likely to be discontinued. This emphasizes the intuition that the older a firm is, the less likely it is to be shut down after being acquired by GAFAM. Conversely, the younger the company is, the more likely it is to be discontinued. This observation was already made by Gautier and Lamesch for the period of 2015 to 2017 and can therefore also be confirmed for the period of 2018 to 2021 with regard to models 4 to 7. This finding provides important implications for the research question, since it shows that younger firms are more likely to be discontinued. This finding will be further discussed in the policy discussion chapter.

Subsequently, the results of the empirical sections of this thesis, which result from the retrospective review of the transactions and from the regression model, are discussed with a view to a policy discussion.

Dependent variable: Discon	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
β_1[Age of the acquired company at the time of acquisition]	-0.00844 (0.00535)	-0.00636 (0.00507)	-0.00666 (0.00517)	-0.00861* (0.00505)	-0.0211** (0.00920)	-0.01000* (0.00534)	-0.00886* (0.00503)
γ_1[Alphabet]	0.0393 (0.0734)	0.0686 (0.0724)	0.0533 (0.0725)	0.0848 (0.0835)	-0.0151 (0.0872)	0.0187 (0.0740)	0.0819 (0.0767)
γ_2[Amazon]	0.0669 (0.0819)	0.0546 (0.0778)	0.0620 (0.0782)	0.0930 (0.0869)	0.0867 (0.0967)	0.0656 (0.0825)	0.0995 (0.0853)
γ_3[Meta]	0.234** (0.0928)	0.258*** (0.0898)	0.253*** (0.0903)	0.281*** (0.100)	0.122 (0.113)	0.240** (0.0952)	0.280*** (0.0934)
γ_4[Apple]	0.383*** (0.0808)	0.377*** (0.0814)	0.366*** (0.0807)	0.429*** (0.0890)	0.395*** (0.0993)	0.355*** (0.0826)	0.440*** (0.0854)
ζ_1[Communication]	-	-0.0477 (0.107)	-	-	-	-	-
ζ_2[Physical]	-	-0.144* (0.0770)	-	-	-	-	-
ζ_3[Digital]	-	-0.217*** (0.0583)	-	-	-	-	-
ζ_4[Advertising]	-	-0.324** (0.161)	-	-	-	-	-
ζ_5[Cloud_Infrastructure]	-	-	0.179*** (0.0537)	-	-	-	-
ζ_6[Core]	-	-	-	0.0831 (0.0795)	-	-	-
ζ_7[Funding in millions of $]	-	-	-	-	-0.000714 (0.000497)	-	-
ζ_8[US]	-	-	-	-	-	-0.0553 (0.0608)	-
ζ_9[Active]	-	-	-	-	-		-0.105 (0.0662)
α[Constant]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
$\delta_{1,2,3,4,5}$[Years Fixed Effects]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	270	270	270	270	180	262	270
Pseudo *R*-squared	0.1450	0.1838	0.1746	0.1481	0.1912	0.1515	0.1519

Average marginal effect. Robust standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Probit estimations 2015-2020
Source: Gautier and Lamesch (2021) and own research based on Crunchbase data

2.5 Policy Discussion

In this study, the research aim is to explore merger and acquisition strategies in the digital economy based on transaction histories of five large technology companies. On the basis of the available data, the objective is to explain potential patterns that explain the incumbency advantages of GAFAM. These advantages may be used by GAFAM to engage in anti-competitive behaviour. Another objective is to examine in detail the acquisitions of acquired companies that are young, active in the main area of economic activity than the acquirer, and are active in activities related to cloud infrastructure in order to detect possible direct or indirect anti-competitive motives. Additionally, the origin and the total funding of the acquired entities are investigated in this context. With possible findings, a policy recommendation can be formulated to create alert signals for competition authorities to more easily identify and address anti-competitive behavior, thus promoting competition in the digital economy.

Subsequently the study discusses the main findings from the retrospective review of GAFAM transactions and from the regression model, followed by potential limitations of the study. It then discusses the policy recommendation for mergers and acquisitions and the possible remedies for the issues at hand in light of the literature.

2.5.1 Key Findings

Based on section 2.3 of the development part of this study, a few key findings can be retained. The data suggests that GAFAM are involved in many M&A and that most of the acquired companies no longer exist under their original names after the acquisition. In total, 177 of the 329 acquisitions GAFAM made between 2015 and 2021 were not continued, representing 54%. The data supports as well the theory that the companies acquired by GAFAM are particularly young. The median age of an acquired company is 5 and the average age is 7. Similarly, the total average funding raised by a company until the time of acquisition is low which confirms that acquired companies are still in their infancy. In addition, the acquired companies are mainly from the United States, accounting for more than 60%. During the period studied, 132 acquisitions were made in the cloud infrastructure group cluster, representing 40% of all GAFAM acquisitions between 2015 and 2021. This evidence shows that targeted companies are mostly working in the field of cloud infrastructure. Discontinuation rate in this cluster is the highest with 64%. Furthermore, none of the tech giants made the highest number of acquisitions in its main cluster, except for Microsoft. Meta and Apple have the highest discontinuation rates among the five big tech companies.

These results obtained in the descriptive statistics part serve as a starting point for the regression analysis. The results of the Probit estimations obtained in section 2.4 show that younger firms are more likely to be discontinued after being acquired by GAFAM. Furthermore, the analysis provides evidence for the fact that companies active in the cloud infrastructure field are more susceptible to being shut down post acquisition. However, the results do not show a causal relationship between discontinuation decisions and overlapping economic activities between the acquirer and the acquired. Nor was it possible to identify a relation between shutdown decisions and the total funding or the origin of the acquired entity. Providing complementary products and services in one of the active clusters of the acquirer does not affect the discontinuation decision either, according to the results obtained.

In summary, the regression analysis identifies the age and operation in the cloud infrastructure field as key factors for shutdown decisions by GAFAM. These two outcomes need to be discussed, as the acquisition and subsequent termination of a company may constitute potential anti-competitive motivations.

First, the identification of age as a driver of shutdown decisions confirms the findings of Gautier and Lamesch (2021) using a subset of this data from 2015 to 2017. According to Gautier and Lamesch, a young start-up company may have an innovative idea that, if developed properly, can threaten the dominant position of the incumbent company in the future. By acquiring the company, the potential competitive threat can be eliminated. The authors point to the growing concern about "killer mergers" that reduce competition by acquiring and closing innovative and young start-ups. However, the results only point to the possible existence of killer mergers, given the causal relationship between GAFAM shutdown decisions and the age of the acquired entity, but do not provide empirical evidence for the actual existence. The reason for this is that the data does not allow to screen between the reasons for the discontinuation. This aspect will be further treated in the limitations sections of this thesis. However, the results do suffice to further address the competition concerns, since some acquisitions might have had a killer merger motive. Hence, the first alarm signal for competition authorities is the young age of an acquired company. Companies that are below a certain age limit should therefore be shortlisted by competition authorities.

Second, the results identify cloud infrastructure as a driver of GAFAM's shutdown decisions. With regard to the literature review, it can be stated that GAFAM are increasingly focusing on activities related to cloud infrastructure. In this thesis, this area of economic activity is accounted for by the cloud infrastructure group cluster that was created. It contains the AI, data science and analytics cluster, the remote storage and file transfer cluster and the other cluster. It can be assumed that the shutdowns of companies in these clusters are not particularly about eliminating a dangerous competitor, but rather about the assets of the company. The reason for this assumption is that the purchased company has an innovative idea in the area of cloud infrastructure, but not yet the required amount of data for economies of scale and to gain an advantage from it. The situation is likely to be the opposite for the large technology companies. Therefore, by acquiring and discontinuing companies active in this field, the aim of GAFAM is to obtain the asset or innovation effort of this company. (Gautier and Lamesch (2021)). This means that GAFAM integrate the acquired entity in their ecosystems, because the acquisition was motivated by the obtaining of the cloud infrastructure technology or the employees. In this way, large amounts of data can be captured, stored, and processed at lower cost, enabling the "execution of the value proposition of the digital business ecosystem" (Moss et al. (2021)). According to Bourreau and Perrot (2020), large technology companies create value with the help of data in two different ways. They improve and personalise their own products based on the preferences of their customers and monetize the data by selling targeted advertising opportunities to advertisers. This competitive advantage and increased market power can therefore lead to anti-competitive behaviour, such as leveraging market power in other markets or creating a barrier to entry for smaller competitors (Bourreau and Perrot (2020)). If GAFAM acquire cloud infrastructure, the acquisition may not have been anti-competitive in itself, but it gives them a big advantage because it gives them so much data that their market power increases to such an extent that they are more likely to engage in anti-competitive practices in the future. Bourreau and Perrot find that the incumbent can maintain its dominant position when an innovative competitor emerges if the data is exclusively available to the incumbent. Thus, the second alarm signal for competition authorities is the cloud infrastructure activity of an acquired company.

As a result of the empirical part, there is evidence that GAFAM is shutting down many companies, which is a cause for concern for competition authorities, as some of them might have an anti-competitive motive. Hence, this study allows to identify age and cloud infrastructure as indicators of termination cases, some of which might turn out to be killer mergers. On the one hand, the shutdown decision might be motivated by the elimination of a potential future competitor. On the other hand, it might be motiv-

ated by gaining a dominant position in the field of cloud infrastructure and engage in anti-competitive behaviour once the dominant position has been achieved. Based on the findings, it is important to review the current legal framework and consider how to formulate an effective policy recommendation in this regard, as large technology companies have been acquiring emerging and pioneering companies for years without any scrutiny or intervention (Holmström et al. (2018)). This recommendation can address the findings discussed above, but before doing so, some limitations are inherent to the study.

2.5.2 Limitations of the Results

In this study, just as in "Mergers in the digital economy" by Gautier and Lamesch (2021), it is not possible to distinguish between the reasons for termination. Apart from the lack of success, Gautier and Lamesch identify two other reasons. On the one hand, GAFAM may only be interested in the production factors, human resources or technology and have no interest in keeping the company running. In the paper "Killer Acquisitions? The Debate on Merger Control for Digital Markets" by Holmström et al. (2018), reference is made to the statement of the founder of Meta, who explained that Meta buys companies to get excellent employees. The authors also explain that people that are capable of running start-ups are a good addition to the team of the incumbent. On the other hand, there may be an anti-competitive motive behind the termination, such as the elimination of a competitive threat and the consolidation of the dominant position. This type of acquisition is referred to as a "killer merger". However, it is not possible to investigate the development of the acquired company after the acquisition because of a lack of data. Overall, even if it is not possible to screen between killer mergers and acquisitions with the motive of acquiring production factors, some of the acquired discontinued companies were discontinued because they could have become potential future threats to the incumbents. This argument thus suffices for alerting competition authorities.

In the light of the paper by Cunningham et al. (2021), acquisitions in the main cluster can be considered as substitutes for the main product of the acquirer and therefore are more likely to be discontinued. Acquisitions of companies operating in one of the active clusters of GAFAM can be considered complements and are therefore less likely to be discontinued, except for some specific clusters. The results of this thesis for the digital economy do not allow to confirm the findings of Cunningham et al. (2021) for the pharmaceutical products. Holmström et al. (2018) point out that acquisitions in the digital technology industry differ from the pharmaceutical industry which Cunningham et al. (2021) analyse. Holmström et al. note that drugs are often characterised by substitutability, as pharmaceutical markets are clearly defined according to the active ingredient of a drug. Digital products, on the other hand, are often seen as complements, as the incumbent can integrate the acquired technology into its platform, for example. Therefore, acquisitions in the main area of economic activity of the acquirer cannot generally be considered as horizontal mergers, even though there is a little horizontal overlap between the main activities of an incumbent and the activities of the acquired entity. Hence, mergers in the main cluster might not be identified as anti-competitive ones, but rather as efficiency enhancing vertical or conglomerate mergers. As discussed in the literature review, these are not as thoroughly addressed as horizontal mergers.

A final limitation concerns the financing and origin of the acquired companies. The results of this work do not allow a conclusion to be drawn about the role of funding and origin in explaining GAFAM shutdown decisions.

2.5.3 Policy Recommendation

Based on the descriptive statistics and Probit estimations, young companies are more prone to be terminated after a GAFAM acquisition. This is a cause for concern since the reason for the acquisition can be the elimination of a potential future competitor to strengthen the market position. Under the current set of rules, young companies do not meet the merger notification thresholds due to their weak financial strength. As young start-ups are particularly exposed, the current legal framework should take into account their current financial strength. Therefore, calls for stricter regulation of big players of the digital economy accumulate. Many authors criticize the current regulation which is considered as too "lenient" and ineffective. McLean (2021) propose a new mechanism that could induce that acquisitions of young and innovative start-ups by big tech giants are brought under more serious merger review. The author refers to the economic Goodwill of a firm that is the "surplus of a firm's total valuation over its net tangible assets". A high economic Goodwill is therefore synonym of expectation of high future profits. The economic Goodwill test therefore reveals which start-up acquisitions inhibit potential competition motivations and also expectations of high profits of the acquired firm in the future. This means that firms with a high Goodwill (high valuation, but very low tangible assets) have high anticipated profits and represent a threat to the incumbents. They are therefore more susceptible to pre-emptive acquisitions. A new policy recommendation can be formulated with respect to this economic Goodwill test and replace the current thresholds for inducing mergers reviews by competition authorities. Thus, high economic Goodwills in mergers can be more rapidly scrutinized and pre-emptive and anti-competitive acquisitions more easily detected. Kühn (2021) also propose a solution based on transaction costs. They investigate the relationship between killer acquisitions and high purchase prices of young start-ups compared to the revenues they generate at the time of the acquisition. Using data from the *CapIQ* M&A database, the authors use the concept of a deal multiple, i.e. the purchase price in relation to the revenues of the acquired company, to identify anti-competitive transactions, i.e. killer acquisitions. The intuition behind this is that high purchase prices of companies indicate that the company could become a true competitor in the future. The outstanding transactions identified by the authors turn out to be the ones that have received the most public attention. This method is designed to help identify young companies that have great potential to become serious competitors to large technology companies and that, following an acquisition, are more likely to be eliminated. The "screen" created by the authors enables the competition authorities to identify anti-competitive transactions ahead of time (Kühn (2021)).

On the basis of the results obtained in the framework of this thesis, consideration must also be given to the increasing importance of data and the ability of digital business ecosystems to collect, store and process data. GAFAM conglomerates increase their mergers activities in the field of cloud infrastructure. Moreover, acquisitions of companies active in this field are more likely to be discontinued. Moss et al. (2021) states that with economies of scale in cloud infrastructure large technology companies can secure dominant positions and therefore have higher incentives to revert to anti-competitive conducts, such as barriers to entry. According to Moss et al, traditional competitive analysis needs to be revised to meet the new challenges posed by data. Bourreau and Perrot (2020) proposes to public authorities an overhaul of current regulations to effectively regulate digital platforms. They see structural separation of dominant platforms as a last resort to prevent dominant companies from anti-competitive conducts. They rather advocate for a central regulator that monitors the activities of digital platforms related to data collection and processing. They also advocate giving competition authorities the ability to directly regulate digital platforms. More importantly, they state that data portability and multi-homing can promote competition. In that way, consumers can switch more easily to competing platforms. However, some of the data might not be compatible with the competing platform or not able to transfer all the

digital connections associated with the data (Bourreau and Perrot (2020)). Therefore, identity portability would be even more effective, which consists in transferring the data and the digital connections associated with the data. A final recommendation concerns data transparency and loyalty. The authors suggest that openness can be improved by implementing application programming interfaces (API) for dominant platforms. Researchers and other interested parties who are experts in the field of algorithms and data can monitor the incumbent's production process and exercise control. However, care must be taken not to share too much information with competitors and hinder innovation efforts. With these means, the economies of scale advantage for cloud infrastructure might therefore be reduced, which lowers the market power of the incumbents and reduces their ability to revert to anti-competitive practices.

Cabral (2021) also gives a policy recommendation with regard to mergers and acquisitions, discouraging start-up innovation. He finds a trade-off between false positives (disallowing a merger that did not have the pre-emptive motive) and false negatives (allowing a merger that did have a pre-emptive motive). Cabral states that for now, no false positives have occurred, since all the the mergers of major digital platforms have been permitted. However, he explains that some false negatives may have occurred and that there has been under-enforcement of digital mergers on the world level. He suggests to reverse the burden of proof for mergers. In that case, the financial burden for competition authorities would be lower. The information asymmetry would tip towards the big players, since they know their businesses far better than the agencies investigating the merger. Also, this would raise the approval bar for mergers, since it would create a bias in favour of the default (the incumbent) who has to prove that the merger is not detrimental to competition. The right policy consists for Cabral in an increase in regulation and not in the stringency of merger review, because of higher consumer protection and higher social welfare.

Overall, the policy recommendation can be summarised as follows. Competition authorities should shortlist mergers and acquisitions that target companies below a certain age threshold. Therefore, an age below the threshold is an alarm signal. Then, by performing the "Economic Goodwill Test" of McLean (2021) or the "Deal Multiple Test" of Kühn (2021), the future competitive potential should be determined. On the basis of the results, companies that could become future competitive threats to the incumbents should be scrutinized thoroughly by competition authorities. To address the increasing role of data and cloud infrastructures, new requirements for tech companies should be introduced. This is the second alarm signal that competition authorities should consider. Especially data portability and multi-homing, combined with competition authorities as a direct regulator ensuring compliance with the requirements should reduce the data dominance of the incumbents and promote competition. However, when a case still raises doubts, then the acquirer should prove that the merger does not have an anti-competitive motive, as suggested by Cabral (2021). It is also important to analyse to what extent the acquisition of a company in the field of cloud infrastructure contributes to the expansion of the incumbent's market dominance. As a last resort, structural separation should be considered .

3 Conclusions

This chapter concludes the study by summarizing the key research findings related to the research objectives and questions and explaining why they are valuable. It will then address some limitations of the study, ways to apply the findings of the thesis and, propose future research opportunities.

3.1 Results and Answer to the Research Question

This study aimed to investigate the merger and acquisition strategies of GAFAM, based on their M&A transaction histories between 2015 and 2021 and to seek explanations for the market power of GAFAM. These are also examined in connection with potential anti-competitive motives. In particular, the roles of age, data, and overlapping economic activities were investigated. In addition, the factors total funding and origin of the acquired entity were examined. The results indicate that most of the companies acquired during this period are no longer running. Further findings show that this is especially true for relatively young companies or companies that are active in the cloud infrastructure sector. No causal relationship was found between GAFAM discontinuation decisions and the overlapping economic activities, origin or funding of an acquired firm. Overall, it can be stated that age and cloud infrastructure activities do play a role in explaining the dominant market positions and market power of GAFAM and potential anti-competitive motives of merger and acquisitions strategies.

The results obtained in the framework of this study show the patterns in GAFAM's current M&A strategies. It is assumed that the acquisition of young companies or companies that are operating in the field of cloud infrastructure could have an anti-competitive motive. Also, the study confirms the growing concerns about the market power of digital incumbents and the urgency of updating the regulatory framework to address the challenges associated with Big Data. This update is essential as only a small proportion of cases are reviewed under the current legal framework and therefore large technology companies are still flying "under the antitrust radar" (Gautier and Lamesch (2021)). Hence, this study fills the research gap on ambiguity of motivations for mergers and acquisitions of GAFAM. It provides a formal review of recent mergers and acquisitions by GAFAM and formulates alarm signals for competition authorities. Moreover, this study confirms the theories on the role of age and cloud infrastructure activities of acquired companies discussed in high-profile reports such as the one by Crémer et al. (2019) for the European Commission and the one by Moss et al. (2021) for the American Antitrust Institute. Policy makers can take actions by implementing the defined alarm signals and by scrutinizing mergers and acquisitions that are highlighted.

3.2 Limitations of the Thesis and Further Research

However, there are still some limitations to this thesis that need to be discussed. First, this thesis does not prove the existence of killer mergers, because the data limits the ability to screen between killer mergers that are intended to reduce competition and "asset acquisitions" which target the assets of the acquired entity (Gautier and Lamesch (2021)). A second limitation is the allocation of clusters to the different acquired companies. The choice of the allocated cluster is arbitrary and solely based on the *Crunchbase* description available. This results in the clusters not perfectly matching the technical and sometimes ambiguous descriptions of the activities. Also, each acquired company was allocated one single cluster, compared to GAFAM which were allocated multiple clusters. Thus it is very restricting to affirm that companies only have one area of economic activity in which they are active. Some of them are even very similar to GAFAM and therefore should theoretically also have more clusters. Third, the

group cluster that was formed in order to represent the dimension of cloud infrastructure in acquisition histories and the group cluster does not perfectly represent the activities that are related to cloud infrastructure. The ”Other” cluster is contained in the group cluster, because the 10K filings do not indicate precise revenues or net sales for this precise cluster. It can be assumed that GAFAM generate annual revenues or net sales that cannot be allocated to any cluster and are therefore considered as ”Other”. Also, it is assumed that activities, which do not match any of the clusters, belong to the cloud infrastructure group cluster.

For further research, one might allocate multiple clusters to the acquired companies and then compare to the clusters of the acquirer. By doing so, it would be possible to create a metric for the overlap rate between the areas of economic activity of the acquired and the acquirer. This would present another possibility for investigating the role of substitutability and identifying mergers that are horizontal mergers rather than conglomerate mergers. One could therefore better explain discontinuation decisions by GAFAM in relation to overlapping activities. Additionally, future research might explore the reasons for the discontinuation decisions by GAFAM in order to provide empirical evidence for killer mergers. By collecting data on patents of startups and their fates after the GAFAM acquisitions, one could potentially demonstrate the acquisition and discontinuation had the underlying intention of restricting competition and consolidating a dominant position.

In summary, this thesis argues that GAFAM’s alleged conglomerate strategies often conceal anticompetitive motives and that the big five are constantly exploring new ways to further secure their dominant positions. Therefore, this thesis proposed key indicators for competition authorities to detect mergers and acquisitions with the latter motive and to stimulate competition in the digital economy.

4 Appendices

4.1 Overview of past acquisitions

Table 8 gives an overall summary of acquisitions per year and for each GAFAM member.

	2015	2016	2017	2018	2019	2020	2021	**Total**
AMZN	9	8	13	4	9	2	5	**50**
APPL	12	8	13	8	9	8	2	**60**
FCBK	8	8	4	5	7	7	5	**44**
GOOG	18	20	14	9	8	8	5	**82**
MSFT	18	11	11	17	13	9	14	**93**
Total	**65**	**55**	**55**	**43**	**46**	**34**	**31**	**329**

Table 8: Number and Years of Acquisitions
Source: Gautier and Lamesch (2021) and own research
based on Crunchbase data

Table 9 displays detailed summary statistics of the database and especially how the observations are distributed in the sample.

(a) Age of Targets

Acquirer	Min	1st Quartile	Median	Mean	3rd Quartile	Max	Nas
All	0	3	5	7	8	97	5
AMZN	1	4	5	9.64	8	97	0
APPL	1	3	5	6.66	9	32	1
FCBK	1	3	4	4.72	6	17	1
GOOG	0	3	4	5.03	7	20	2
MSFT	1	4	7	8.57	11.5	39	1

(b) Total Amount of Funding (in million $)

Acquirer	Min	1st Quartile	Median	Mean	3rd Quartile	Max	Nas
All	0.015	3.12	9.5	43.90	26	1000	112
AMZN	0.05	2.4	10	61.96	26.5	1000	13
APPL	0.35	2.5	8.45	60.86	27.87	1000	20
FCBK	0.12	3.5	5.65	43.89	20	173.5	18
GOOG	0.015	2	6.75	31.57	20.4	352.5	30
MSFT	0.25	5.5	14.53	41.04	31.4	574.9	31

Table 9: Summary statistics
Source: Gautier and Lamesch (2021) and own research
based on Crunchbase data

Table 10 shows the breakdown of continuation and discontinuation of the acquired companies by GAFAM per cluster and group cluster.

	ATP	CAT	DC & HW & TD	PGS	RS & AI & O	Total
discontinued	2 (33.33%)	13 (59.09%)	48 (44.44%)	29 (47.54%)	85 (64.39%)	177 (53.80%)
NA	0 (0.00%)	2 (9.09%)	5 (4.63%)	7 (11.48%)	13 (9.85%)	27 (8.21%)
running	4 (66.67%)	7 (31.82%)	55 (50.93%)	25 (40.98%)	34 (25.76%)	125 (37.99%)
Total	**6**	**22**	**108**	**61**	**132**	**329**

Table 10: Operating Status per Cluster (Grouped)
Source: Gautier and Lamesch (2021) and own research based on Crunchbase data

Tables 11 and 12 show the number of acquisitions per cluster for each GAFAM member.

	ATP	AI	CAT	DC	HW	O	PGS	RS	TD	**Total**
AMZN	2	16	5	4	2	1	10	6	4	**50**
APPL	0	27	1	10	6	2	11	1	2	**60**
FCBK	1	12	5	9	3	1	8	1	4	**44**
GOOG	2	14	6	7	8	6	12	8	19	**82**
MSFT	1	27	5	15	4	5	20	5	11	**93**
Total	**6**	**96**	**22**	**45**	**23**	**15**	**61**	**21**	**40**	**329**

Table 11: Acquisitions per cluster
Source: Gautier and Lamesch (2021) and own research based on Crunchbase data

	ATP	CAT	DC & HW & TD	PGS	RS & AI & O	Total
AMAZON	2	5	10	10	23	50
APPLE		1	18	11	30	60
META	1	5	16	8	14	44
ALPHABET	2	6	34	12	28	82
MICROSOFT	1	5	30	20	37	93
Total	**6**	**22**	**108**	**61**	**132**	**329**

Table 12: Acquisitions per cluster (Grouped)
Source: Gautier and Lamesch (2021) and own research based on Crunchbase data

Number of acquisitions per cluster (Ungrouped)

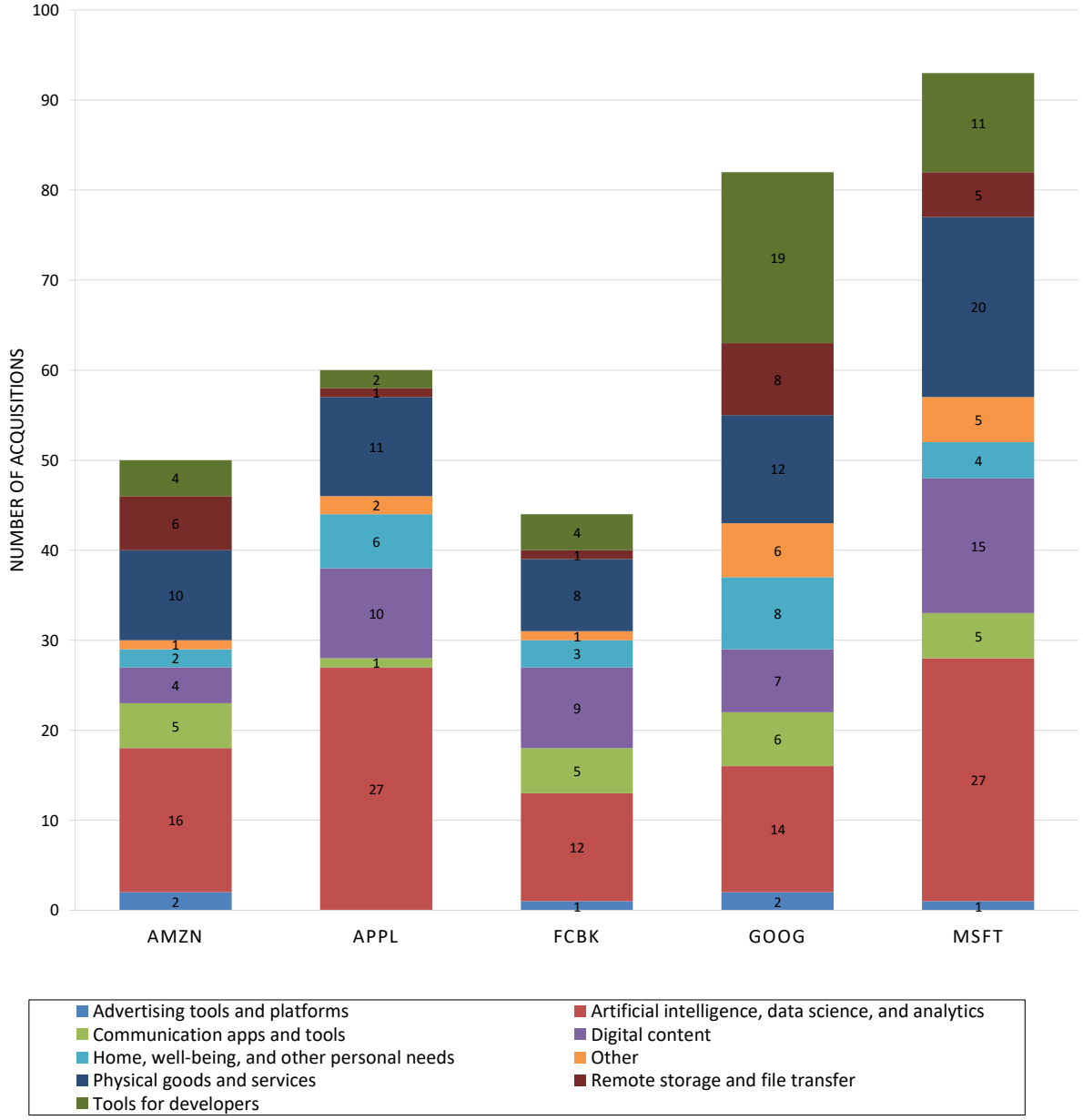

Figure 10: Number of acquisitions per cluster (Ungrouped)
Source: Gautier and Lamesch (2021) and own research
based on Crunchbase data

4.2 Revenue Sources of GAFAM in clusters (as per 10k filings)

A) Amazon

Clusters	Revenues 2014		Revenues 2017		Revenues 2020	
	Amount	Share	Amount	Share	Amount	Share
Digital content & Home, well-being, and other personal needs & Tools for developers	22,505	25.29%	9,721	5.47%	25,207	6.53%
Physical goods and services	60,886	68.42%	146,033	82.10%	294,034	76.16%
Advertising tools and platforms			4,653	2.62%	21,453	5.56%
Remote Storage and file transfer & Artificial intelligence, data science, and analytics & Other	5,597	6.29%	17,459	9.82%	45,370	11.75%
Total	88,988	100%	177,866	100%	386,064	100%

Table 13: Annual Net Sales of Amazon
Source: Amazon's 10k filings 2014 (p.27), 2017 (p.69) and, 2020 (p.66).
Amounts in million $.

B) Apple

Clusters	Revenues 2014		Revenues 2017		Revenues 2020	
	Amount	Share	Amount	Share	Amount	Share
Communication apps and tools	158,639	86.79%	186,391	81.31%	190,127	69.26%
Digital content & Home, well-being, and other personal needs & Tools for developers	18,063	9.88%	29,980	13.08%	53,768	19.59%
Physical goods and services	6,093	3.33%	12,863	5.61%	30,620	11.15%
Total	182,795	100%	229,234	100%	274,515	100%

Table 14: Annual Net Sales of Apple
Source: Apple's 10k filings 2014 (p.27), 2017 (p.23) and, 2020 (p.21).
Amounts in million $.

C) Meta

Clusters	Revenues 2014		Revenues 2017		Revenues 2020	
	Amount	Share	Amount	Share	Amount	Share
Digital content & Home, well-being, and other personal needs & Tools for developers	974	7.81%	711	1.75%	1,796	2.09%
Advertising tools and platforms	11,492	92.19%	39,942	98.25%	84,169	97.91%
Total	12,466	100%	40,653	100%	85,965	100%

Table 15: Annual Revenues of Meta
Source: Meta's 10k filings 2014 (p.43), 2017 (p.43) and, 2020 (p.66).
Amounts in million $.

D) Alphabet

Clusters	Revenues 2014		Revenues 2017		Revenues 2020	
	Amount	Share	Amount	Share	Amount	Share
Digital content & Home, well-being, and other personal needs & Tools for developers	6,945	10.52%	14,277	12.88%	21,711	11.89%
Advertising tools and platforms	59,056	89.48%	95,375	86.04%	146,924	80.49%
Remote Storage and file transfer & Artificial intelligence, data science, and analytics & Other			1,203	1.09%	13,892	7.61%
Total	66,001	100%	110,855	100%	182,527	100%

Table 16: Annual Revenues of Alphabet
Source: Alphabet's 10k filings 2014 (p.23), 2017 (p.28) and, 2020 (p.33).
Amounts in million $.

E) Microsoft

Clusters	Revenues 2014		Revenues 2017		Revenues 2020	
	Amount	Share	Amount	Share	Amount	Share
Communication apps and tools	30,455	35.07%	24,706	27.47%	48,403	33.84%
Physical goods and services	29,090	33.50%	30,977	34.44%	41,725	29.18%
Advertising tools and platforms	4,016	4.62%	6,971	7.75%	7,740	5.41%
Remote Storage and file transfer & Artificial intelligence, data science, and analytics & Other	23,272	26.80%	27,296	30.35%	45,147	31.57%
Total	86,833	100%	89,850	100%	143,015	100%

Table 17: Annual Revenues of Microsoft
Source: Microsoft's 10k filings 2014 (p.93), 2017 (p.92) and, 2020 (p.92).
Amounts in million $.

4.3 Robustness Check

Dependent variable: Discon	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
β_1[Age of the acquired company at the time of acquisition]	-0.00821* (0.00496)	-0.00611 (0.00458)	-0.00633 (0.00468)	-0.00835* (0.00463)	-0.0177** (0.00871)	-0.00968* (0.00498)	-0.00869* (0.00462)
γ_1[Alphabet]	0.0547 (0.0684)	0.0881 (0.0675)	0.0731 (0.0679)	0.106 (0.0772)	0.0192 (0.0822)	0.0358 (0.0693)	0.101 (0.0704)
γ_2[Amazon]	0.0842 (0.0765)	0.0739 (0.0722)	0.0811 (0.0722)	0.115 (0.0812)	0.115 (0.0898)	0.0820 (0.0767)	0.124 (0.0800)
γ_3[Meta]	0.214*** (0.0814)	0.240*** (0.0777)	0.233*** (0.0782)	0.266*** (0.0877)	0.126 (0.0989)	0.218*** (0.0826)	0.269*** (0.0821)
γ_4[Apple]	0.404*** (0.0768)	0.399*** (0.0778)	0.389*** (0.0768)	0.456*** (0.0834)	0.417*** (0.0947)	0.376*** (0.0786)	0.469*** (0.0800)
ζ_1[Communication]	-	-0.0603 (0.0980)	-	-	-	-	-
ζ_2[Physical]	-	-0.140* (0.0717)	-	-	-	-	-
ζ_3[Digital]	-	-0.224*** (0.0538)	-	-	-	-	-
ζ_4[Advertising]	-	-0.343** (0.138)	-	-	-	-	-
ζ_5[Cloud_Infrastructure]	-	-	0.184*** (0.0496)	-	-	-	-
ζ_6[Core]	-	-	-	0.0936 (0.0741)	-	-	-
ζ_7[Funding in millions of $]	-	-	-	-	-0.000863 (0.000575)	-	-
ζ_8[US]	-	-	-	-	-	-0.0567 (0.0559)	-
ζ_9[Active]	-	-	-	-	-	-	-0.123** (0.0616)
α[Constant]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
$\delta_{1,2,3,4,5,6}$[Years Fixed Effects]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	300	300	300	300	202	292	300
Pseudo *R*-squared	0.1921	0.2340	0.2243	0.1961	0.2215	0.2003	0.2018

Average marginal effect. Robust standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 18: Probit estimations 2015 -2021
Source: Gautier and Lamesch (2021) and own research based on Crunchbase data

4.4 Decision tree for data

In order to assess whether a product of an acquired startup or business can be considered as continued or discontinued (in 2022), a few decision criteria are specified. The criteria are based on the following reflection of Gautier and Lamesch (2021):

- The companies themselves notify that their product has been stopped.
- The website of the company is offline.
- The website of is still online, but there are no longer any products on offer.
- The website of is still online, but the company announced that support has stopped and that it will no longer off updates.

Figure 11 graphically represents this decision tree to determine the post acquisition operating status of the companies acquired by GAFAM.

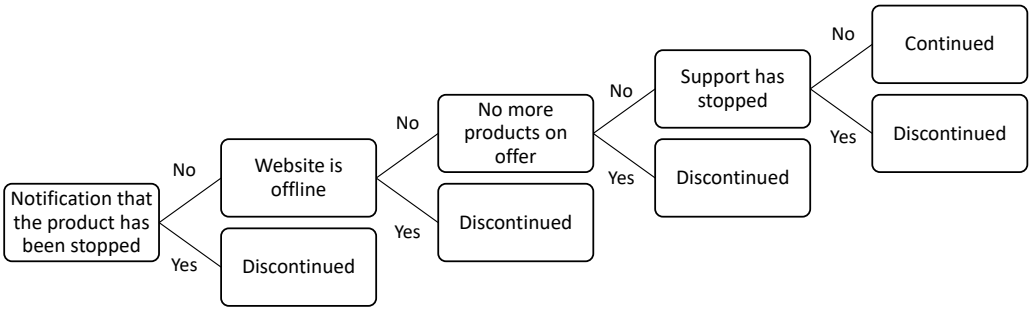

Figure 11: Decision tree for company operating status
Source: Gautier and Lamesch (2021)

4.5 List of GAFAM mergers and acquisitions between 2015 and 2021

For the allocation of clusters to the different acquired or merged companies, the description of companies of ”Crunchbase” is used. The latter contains information on the main economic activity of the company. In that way, clusters are allocated with regards to the definitions of areas of economic activity by Argentesi et al. (2021). However, the matching of the description of the activity of the acquired company with the description of the clusters of Argentesi is not always perfectly straightforward. For this reason, the allocation is mostly based on intuitions. Below, one can find a list of each of m&a case identified between 2015 and 2021 and the respective cluster that was assigned (Source: Gautier and Lamesch (2021) and own research, based on Crunchbase data).

No.	Company Name	Acquirer	Acquisition Year	Continuation	Cluster
1	Shoefitr	AMZN	2015	discont.	DC & HW & TD
2	Amiato	AMZN	2015	NA	RS & AI & O
3	Annapurna Labs	AMZN	2015	NA	RS & AI & O
4	Clusterk	AMZN	2015	discont.	RS & AI & O
5	AppThwack	AMZN	2015	discont.	PGS
6	2lemetry	AMZN	2015	discont.	RS & AI & O
7	Orbeus	AMZN	2015	discont.	RS & AI & O
8	Safaba Translation Solutions	AMZN	2015	discont.	RS & AI & O
9	Elemental Technologies	AMZN	2015	discont.	RS & AI & O
10	NICE	AMZN	2016	running	RS & AI & O
11	Cloud9 IDE	AMZN	2016	running	RS & AI & O
12	Curse	AMZN	2016	NA	DC & HW & TD
13	EMVANTAGE Payments	AMZN	2016	discont.	RS & AI & O
14	Angel.ai	AMZN	2016	discont.	RS & AI & O
15	Partpic	AMZN	2016	discont.	RS & AI & O
16	Biba	AMZN	2016	discont.	CAT
17	Westland	AMZN	2016	discont.	PGS
18	harvest.ai	AMZN	2017	discont.	RS & AI & O
19	Dispatch	AMZN	2017	NA	RS & AI & O
20	Dispatch	AMZN	2017	NA	RS & AI & O
21	WING	AMZN	2017	running	PGS
22	Body Labs	AMZN	2017	discont.	RS & AI & O
23	GameSparks	AMZN	2017	running	RS & AI & O
24	Do	AMZN	2017	discont.	CAT
25	Souq	AMZN	2017	running	PGS
26	Graphiq	AMZN	2017	discont.	RS & AI & O
27	Blink	AMZN	2017	running	PGS
28	Whole Foods Market	AMZN	2017	running	PGS
29	Thinkbox Software	AMZN	2017	running	RS & AI & O
30	ClipMine	AMZN	2017	discont.	DC & HW & TD
31	Sqrrl	AMZN	2018	discont.	RS & AI & O
32	PillPack	AMZN	2018	running	DC & HW & TD
33	Tapzo	AMZN	2018	discont.	PGS
34	Ring	AMZN	2018	running	PGS
35	Eero	AMZN	2019	running	PGS

No.	Company Name	Acquirer	Acquisition Year	Continuation	Cluster
36	Bebo	AMZN	2019	running	CAT
37	Canvas Technology	AMZN	2019	discont.	RS & AI & O
38	CloudEndure	AMZN	2019	discont.	RS & AI & O
39	E8 Storage	AMZN	2019	discont.	RS & AI & O
40	IGDB.com	AMZN	2019	running	DC & HW & TD
41	INLT	AMZN	2019	running	PGS
42	Sizmek Ad Server and Sizmek Dynamic Creative Optimization (parts)	AMZN	2019	running	ATP
43	TSO Logic	AMZN	2019	discont.	RS & AI & O
44	Wondery	AMZN	2020	running	CAT
45	Zoox	AMZN	2020	running	RS & AI & O
46	Art19	AMZN	2021	running	ATP
47	Metro-Goldwyn-Mayer	AMZN	2021	running	DC & HW & TD
48	Umbrad 3D	AMZN	2021	discont.	RS & AI & O
49	Wickr	AMZN	2021	running	CAT
50	FoundationDB	APPL	2015	running	PGS
51	Mapsense	APPL	2015	discont.	RS & AI & O
52	Linx Imaging	APPL	2015	discont.	PGS
53	Semetric	APPL	2015	discont.	RS & AI & O
54	Privaris	APPL	2015	NA	PGS
55	faceshift	APPL	2015	discont.	RS & AI & O
56	Dryft	APPL	2015	NA	RS & AI & O
57	Coherent Navigation	APPL	2015	discont.	DC & HW & TD
58	Camel Audio	APPL	2015	discont.	DC & HW & TD
59	Perceptio	APPL	2015	NA	RS & AI & O
60	VocalIQ	APPL	2015	discont.	RS & AI & O
61	Metaio	APPL	2015	discont.	PGS
62	LearnSprout	APPL	2016	discont.	RS & AI & O
63	tuplejump	APPL	2016	discont.	RS & AI & O
64	Turi	APPL	2016	discont.	RS & AI & O
65	LegbaCore	APPL	2016	discont.	PGS
66	Emotient	APPL	2016	discont.	RS & AI & O
67	Gliimpse	APPL	2016	discont.	DC & HW & TD
68	indoor.io	APPL	2016	discont.	DC & HW & TD
69	Flyby Media	APPL	2016	discont.	CAT
70	Lattice	APPL	2017	discont.	RS & AI & O

No.	Company Name	Acquirer	Acquisition Year	Continuation	Cluster
71	init.ai	APPL	2017	discont.	RS & AI & O
72	RealFace	APPL	2017	discont.	RS & AI & O
73	SensoMotoric Instruments (SMI)	APPL	2017	discont.	RS & AI & O
74	Beddit	APPL	2017	running	DC & HW & TD
75	Shazam Entertainment	APPL	2017	running	DC & HW & TD
76	Regaind	APPL	2017	discont.	DC & HW & TD
77	Pop Up Archive	APPL	2017	discont.	DC & HW & TD
78	Workflow	APPL	2017	running	RS & AI & O
79	InVisage Technologies	APPL	2017	discont.	PGS
80	Spektral	APPL	2017	discont.	DC & HW & TD
81	Vrvana	APPL	2017	discont.	PGS
82	PowerbyProxi	APPL	2017	discont.	RS & AI & O
83	Silk Labs	APPL	2018	discont.	RS & AI & O
84	Silicon Valley Data Science	APPL	2018	discont.	RS & AI & O
85	Akonia Holographics	APPL	2018	discont.	RS & AI & O
86	Buddybuild	APPL	2018	discont.	RS & AI & O
87	Asaii	APPL	2018	discont.	DC & HW & TD
88	Texture (Next Issue Media)	APPL	2018	discont.	DC & HW & TD
89	Dialog Semiconductor (portions)	APPL	2018	NA	PGS
90	Platoon	APPL	2018	running	RS & AI & O
91	Camerai	APPL	2019	discont.	RS & AI & O
92	Drive.ai	APPL	2019	discont.	RS & AI & O
93	Ikinema	APPL	2019	discont.	RS & AI & O
94	Laserlike	APPL	2019	discont.	RS & AI & O
95	PullString	APPL	2019	discont.	RS & AI & O
96	Spectral Edge	APPL	2019	discont.	RS & AI & O
97	Stamplay	APPL	2019	discont.	RS & AI & O
98	Tueo Health	APPL	2019	discont.	DC & HW & TD
99	Intel's smartphone modem business	APPL	2019	NA	PGS
100	Fleetsmith	APPL	2020	running	PGS
101	Mobeewave	APPL	2020	discont.	PGS
102	NextVR	APPL	2020	discont.	DC & HW & TD
103	Scout FM	APPL	2020	discont.	DC & HW & TD
104	Spaces	APPL	2020	discont.	RS & AI & O
105	The Dark Sky Company	APPL	2020	running	DC & HW & TD

No.	Company Name	Acquirer	Acquisition Year	Continuation	Cluster
106	Voysis	APPL	2020	discont.	RS & AI & O
107	Xnor.ai	APPL	2020	discont.	RS & AI & O
108	Curious AI	APPL	2021	discont.	RS & AI & O
109	Primephonic	APPL	2021	discont.	DC & HW & TD
110	Tugboat Yards	META	2015	discont.	ATP
111	Wit.ai	META	2015	running	RS & AI & O
112	Pebbles Interfaces	META	2015	discont.	RS & AI & O
113	Endaga	META	2015	discont.	CAT
114	TheFind, Inc.	META	2015	discont.	PGS
115	Teehan+Lax	META	2015	discont.	DC & HW & TD
116	QuickFire Networks	META	2015	discont.	RS & AI & O
117	Surreal Vision Ltd	META	2015	discont.	PGS
118	CrowdTangle	META	2016	running	RS & AI & O
119	FacioMetrics	META	2016	discont.	RS & AI & O
120	Nascent Objects Inc	META	2016	discont.	PGS
121	The Eye Tribe	META	2016	NA	PGS
122	InfiniLED	META	2016	discont.	PGS
123	Eyegroove	META	2016	discont.	CAT
124	Masquerade	META	2016	running	CAT
125	Two Big Ears Ltd	META	2016	NA	PGS
126	Source3	META	2017	discont.	RS & AI & O
127	Ozlo	META	2017	discont.	RS & AI & O
128	tbh	META	2017	NA	CAT
129	Fayteq AG	META	2017	discont.	RS & AI & O
130	Bloomsbury AI	META	2018	discont.	RS & AI & O
131	Confirm	META	2018	discont.	RS & AI & O
132	Dreambit	META	2018	discont.	DC & HW & TD
133	Redkix	META	2018	discont.	CAT
134	Vidpresso	META	2018	discont.	DC & HW & TD
135	Beat Games	META	2019	running	DC & HW & TD
136	Chainspace	META	2019	NA	RS & AI & O
137	CTRL-labs	META	2019	discont.	RS & AI & O
138	GrokStyle	META	2019	discont.	RS & AI & O
139	Packagd	META	2019	discont.	PGS
140	PlayGiga	META	2019	discont.	DC & HW & TD

No.	Company Name	Acquirer	Acquisition Year	Continuation	Cluster
141	Servicefriend	META	2019	discont.	RS & AI & O
142	Giphy	META	2020	running	DC & HW & TD
143	Kustomer	META	2020	running	RS & AI & O
144	Lemnis Technologies	META	2020	discont.	PGS
145	Mapillary	META	2020	running	DC & HW & TD
146	Ready at Dawn	META	2020	running	DC & HW & TD
147	Sanzaru Games	META	2020	discont.	DC & HW & TD
148	Scape Technologies	META	2020	discont.	RS & AI & O
149	AI.Reverie	META	2021	discont.	RS & AI & O
150	BigBox VR	META	2021	running	DC & HW & TD
151	Downpour Interactive	META	2021	running	DC & HW & TD
152	Unit 2 Games	META	2021	running	DC & HW & TD
153	Within	META	2021	running	RS & AI & O
154	Granata Decision Systems	ALPH	2015	NA	RS & AI & O
155	Bebop	ALPH	2015	discont.	RS & AI & O
156	Apportable	ALPH	2015	discont.	RS & AI & O
157	Divshot	ALPH	2015	discont.	RS & AI & O
158	Pixate	ALPH	2015	running	RS & AI & O
159	Pulse.io	ALPH	2015	discont.	RS & AI & O
160	Oyster	ALPH	2015	discont.	DC & HW & TD
161	Launchpad Toys	ALPH	2015	discont.	DC & HW & TD
162	Digisfera	ALPH	2015	discont.	RS & AI & O
163	Jibe Mobile	ALPH	2015	NA	CAT
164	Softcard	ALPH	2015	discont.	RS & AI & O
165	Agawi Inc	ALPH	2015	discont.	DC & HW & TD
166	Toro	ALPH	2015	discont.	ATP
167	Odysee	ALPH	2015	discont.	CAT
168	Fly Labs	ALPH	2015	discont.	RS & AI & O
169	Timeful	ALPH	2015	discont.	DC & HW & TD
170	Skillman & Hackett	ALPH	2015	running	RS & AI & O
171	Thrive Audio	ALPH	2015	discont.	RS & AI & O
172	Orbitera, Inc.	ALPH	2016	running	PGS
173	Qwiklabs	ALPH	2016	running	RS & AI & O
174	Anvato	ALPH	2016	running	RS & AI & O
175	Apigee	ALPH	2016	running	RS & AI & O

No.	Company Name	Acquirer	Acquisition Year	Continuation	Cluster
176	LaunchKit	ALPH	2016	discont.	RS & AI & O
177	Bandpage	ALPH	2016	discont.	CAT
178	FameBit	ALPH	2016	running	ATP
179	LeapDroid	ALPH	2016	discont.	RS & AI & O
180	Moodstocks	ALPH	2016	discont.	RS & AI & O
181	Webpass	ALPH	2016	running	PGS
182	Urban Engines	ALPH	2016	discont.	RS & AI & O
183	Subarctic Limited	ALPH	2016	NA	RS & AI & O
184	Cronologics Corporation	ALPH	2016	discont.	PGS
185	Synergyse	ALPH	2016	discont.	RS & AI & O
186	Pie	ALPH	2016	discont.	CAT
187	Undecidable Labs	ALPH	2016	NA	PGS
188	Kifi	ALPH	2016	discont.	RS & AI & O
189	Dialogflow	ALPH	2016	running	RS & AI & O
190	Hark	ALPH	2016	NA	RS & AI & O
191	Eyefluence	ALPH	2016	discont.	PGS
192	Halli Labs	ALPH	2017	discont.	RS & AI & O
193	Kaggle	ALPH	2017	running	RS & AI & O
194	AppBridge	ALPH	2017	running	RS & AI & O
195	Bitium	ALPH	2017	running	RS & AI & O
196	Crashlytics	ALPH	2017	running	RS & AI & O
197	Fastlane	ALPH	2017	running	RS & AI & O
198	Redux ST	ALPH	2017	NA	RS & AI & O
199	Owlchemy Labs	ALPH	2017	running	DC & HW & TD
200	Senosis Health	ALPH	2017	NA	DC & HW & TD
201	Relay Media	ALPH	2017	discont.	RS & AI & O
202	HTC - Pixel Phone Division	ALPH	2017	discont.	PGS
203	AIMatter	ALPH	2017	running	RS & AI & O
204	60dB	ALPH	2017	discont.	DC & HW & TD
205	Limes Audio	ALPH	2017	discont.	CAT
206	Cask	ALPH	2018	running	RS & AI & O
207	DevOps Research and Assessment	ALPH	2018	running	PGS
208	GraphicsFuzz	ALPH	2018	discont.	RS & AI & O
209	Onward	ALPH	2018	running	RS & AI & O
210	Redux	ALPH	2018	discont.	PGS

No.	Company Name	Acquirer	Acquisition Year	Continuation	Cluster
211	Sigmoid Labs (Where Is My Train)	ALPH	2018	running	DC & HW & TD
212	Tenor Inc	ALPH	2018	running	CAT
213	Velostrata	ALPH	2018	discont.	RS & AI & O
214	Workbench Education	ALPH	2018	discont.	DC & HW & TD
215	Alooma	ALPH	2019	running	RS & AI & O
216	CloudSimple	ALPH	2019	discont.	RS & AI & O
217	Elastifile	ALPH	2019	running	RS & AI & O
218	Looker	ALPH	2019	running	RS & AI & O
219	Nightcorn	ALPH	2019	discont.	DC & HW & TD
220	Socratic	ALPH	2019	running	DC & HW & TD
221	Superpod	ALPH	2019	discont.	DC & HW & TD
222	Typhoon Studios	ALPH	2019	discont.	DC & HW & TD
223	Actifio	ALPH	2020	discont.	RS & AI & O
224	AppSheet	ALPH	2020	running	RS & AI & O
225	Cornerstone	ALPH	2020	NA	RS & AI & O
226	Dataform	ALPH	2020	running	RS & AI & O
227	Neverware	ALPH	2020	running	DC & HW & TD
228	North	ALPH	2020	discont.	PGS
229	Pointy	ALPH	2020	running	PGS
230	Stratozone	ALPH	2020	discont.	RS & AI & O
231	Dysonics	ALPH	2021	discont.	PGS
232	Fitbit	ALPH	2021	running	PGS
233	MuJoCo	ALPH	2021	running	RS & AI & O
234	Playspace	ALPH	2021	running	DC & HW & TD
235	Provino (Technologies)	ALPH	2021	running	RS & AI & O
236	N-Trig	MSFT	2015	discont.	PGS
237	Datazen Software	MSFT	2015	NA	RS & AI & O
238	Revolution Analytics	MSFT	2015	NA	RS & AI & O
239	BlueStripe	MSFT	2015	discont.	RS & AI & O
240	Metanautix	MSFT	2015	discont.	RS & AI & O
241	Adxstudio	MSFT	2015	running	PGS
242	FantasySalesTeam	MSFT	2015	discont.	PGS
243	FieldOne Systems	MSFT	2015	discont.	PGS
244	Adallom	MSFT	2015	discont.	RS & AI & O
245	Secure Islands Technologies	MSFT	2015	discont.	PGS

No.	Company Name	Acquirer	Acquisition Year	Continuation	Cluster
246	Havok	MSFT	2015	running	DC & HW & TD
247	Double Labs	MSFT	2015	NA	PGS
248	VoloMetrix	MSFT	2015	discont.	RS & AI & O
249	6Wunderkinder / Wunderlist	MSFT	2015	running	PGS
250	LiveLoop	MSFT	2015	discont.	RS & AI & O
251	Mobile Data Labs	MSFT	2015	running	RS & AI & O
252	Sunrise	MSFT	2015	running	RS & AI & O
253	Talko	MSFT	2015	discont.	CAT
254	Solair	MSFT	2016	discont.	DC & HW & TD
255	Event Zero	MSFT	2016	running	PGS
256	Xamarin	MSFT	2016	NA	RS & AI & O
257	MinecraftEdu	MSFT	2016	running	DC & HW & TD
258	Mixer	MSFT	2016	running	DC & HW & TD
259	SwiftKey	MSFT	2016	running	PGS
260	Wand Labs	MSFT	2016	discont.	CAT
261	Groove (dba Zikera)	MSFT	2016	running	RS & AI & O
262	Genee	MSFT	2016	discont.	RS & AI & O
263	LinkedIn	MSFT	2016	running	CAT
264	PointDrive	MSFT	2016	discont.	RS & AI & O
265	Cloudyn	MSFT	2017	discont.	RS & AI & O
266	Cycle Computing	MSFT	2017	running	PGS
267	Deis.com	MSFT	2017	discont.	PGS
268	Hexadite	MSFT	2017	discont.	PGS
269	Donya Labs	MSFT	2017	running	RS & AI & O
270	Open Build Service	MSFT	2017	running	RS & AI & O
271	Swing Technologies	MSFT	2017	discont.	DC & HW & TD
272	Intentional Software	MSFT	2017	discont.	RS & AI & O
273	Maluuba	MSFT	2017	NA	RS & AI & O
274	Heighten	MSFT	2017	discont.	PGS
275	AltspaceVR	MSFT	2017	running	CAT
276	Avere Systems	MSFT	2018	running	RS & AI & O
277	Bonsai	MSFT	2018	running	RS & AI & O
278	Compulsion Games	MSFT	2018	running	DC & HW & TD
279	Flipgrid	MSFT	2018	running	DC & HW & TD
280	FSLogix	MSFT	2018	discont.	RS & AI & O

No.	Company Name	Acquirer	Acquisition Year	Continuation	Cluster
281	GitHub	MSFT	2018	running	RS & AI & O
282	Glint	MSFT	2018	running	PGS
283	InXile Entertainment	MSFT	2018	running	DC & HW & TD
284	Lobe	MSFT	2018	running	RS & AI & O
285	Ninja Theory	MSFT	2018	running	DC & HW & TD
286	Obsidian Entertainment	MSFT	2018	running	DC & HW & TD
287	PlayFab	MSFT	2018	running	DC & HW & TD
288	Playground Games	MSFT	2018	running	DC & HW & TD
289	Semantic Machines	MSFT	2018	running	RS & AI & O
290	Spectrum	MSFT	2018	discont.	CAT
291	Undead Labs	MSFT	2018	running	DC & HW & TD
292	XOXCO	MSFT	2018	discont.	RS & AI & O
293	Blue Talon	MSFT	2019	discont.	RS & AI & O
294	Citus Data	MSFT	2019	running	RS & AI & O
295	DataSense (belonged to Bright Bytes)	MSFT	2019	discont.	RS & AI & O
296	Dependabot	MSFT	2019	running	RS & AI & O
297	Double Fine Productions	MSFT	2019	running	DC & HW & TD
298	Drawbridge	MSFT	2019	discont.	RS & AI & O
299	Express Logic	MSFT	2019	discont.	RS & AI & O
300	jClarity	MSFT	2019	discont.	PGS
301	Mover	MSFT	2019	discont.	RS & AI & O
302	Movere	MSFT	2019	discont.	RS & AI & O
303	PromoteIQ	MSFT	2019	running	PGS
304	Pull Panda	MSFT	2019	running	RS & AI & O
305	Semmle	MSFT	2019	discont.	RS & AI & O
306	ADRM Software	MSFT	2020	discont.	RS & AI & O
307	Affirmed Networks	MSFT	2020	running	RS & AI & O
308	CyberX	MSFT	2020	discont.	RS & AI & O
309	Metaswitch Networks	MSFT	2020	running	RS & AI & O
310	npm	MSFT	2020	running	RS & AI & O
311	Orions Systems	MSFT	2020	discont.	RS & AI & O
312	Smash.gg	MSFT	2020	running	DC & HW & TD
313	Softomotive	MSFT	2020	discont.	RS & AI & O
314	ZeniMax Media	MSFT	2020	running	DC & HW & TD
315	Ally.io	MSFT	2021	running	RS & AI & O

No.	Company Name	Acquirer	Acquisition Year	Continuation	Cluster
316	Clear Software	MSFT	2021	running	PGS
317	Clipchamp	MSFT	2021	running	DC & HW & TD
318	CloudKnox (Security)	MSFT	2021	running	RS & AI & O
319	Kinvolk	MSFT	2021	running	PGS
320	Nuance Communications, Inc	MSFT	2021	running	RS & AI & O
321	Peer5	MSFT	2021	running	DC & HW & TD
322	ReFirm Labs	MSFT	2021	discont.	RS & AI & O
323	RiskIQ	MSFT	2021	running	RS & AI & O
324	Suplari	MSFT	2021	running	PGS
325	TakeLessons	MSFT	2021	running	DC & HW & TD
326	The Marsden Group	MSFT	2021	running	RS & AI & O
327	Two Hat (Security)	MSFT	2021	running	PGS
328	Veeqo	AMZN	2021	running	RS & AI & O
329	Xandr	MSFT	2021	running	ATP

4.6 Stata Do-File

MASTER THESIS - Do-File.do - Printed on 20.05.2022 21:47:19

```
1   //MASTER THESIS - Do-File
2
3   clear all
4   capture log close
5   set more off
6
7   cd "C:\Users\rober\OneDrive\Université\Master 2\Master Thesis\STATA Part\" //specify your
    own working directory
8
9   import excel "C:\Users\rober\OneDrive\Université\Master 2\Master Thesis\STATA
    Part\MT_DATA_STATA.xlsx", sheet("Working Sample") firstrow clear
10
11  save "C:\Users\rober\OneDrive\Université\Master 2\Master Thesis\STATA
    Part\MAITRY_Database_MT.dta",replace
12
13  log using MT_Do-File.txt, text replace
14
15  use MAITRY_Database_MT.dta, clear
16
17  destring Totalfunding, generate(funding) force
18  gen funding_mill = funding/1000000
19  destring Fundingrounds, generate(Funding_rounds) force
20
21  destring Ageinyears, generate(Age) force
22
23  sum
24
25  // DISCONTINUATION binary dependent variable
26
27  gen DISCON=0
28  replace DISCON = 1 if Continuation=="discont."
29  replace DISCON =. if Continuation=="NA"
30
31  // Acquirer Dummies
32
33  gen GOOG=.0
34  replace GOOG = 1 if Acquirer=="GOOG"
35
36  gen AMZN=0
37  replace AMZN = 1 if Acquirer=="AMZN"
38
39  gen FCBK=0
40  replace FCBK = 1 if Acquirer=="FCBK"
41
42  gen APPL=0
43  replace APPL = 1 if Acquirer=="APPL"
44
45  gen MSFT=0
46  replace MSFT = 1 if Acquirer=="MSFT"
47
48  global alist GOOG AMZN FCBK APPL
49
50
51  //GAFAM variable
52
53  gen GAFAM=.
54  replace GAFAM=1 if Acquirer=="MSFT"
55  replace GAFAM=2 if Acquirer=="GOOG"
56  replace GAFAM=3 if Acquirer=="AMZN"
57  replace GAFAM=4 if Acquirer=="APPL"
58  replace GAFAM=5 if Acquirer=="FCBK"
59
60  // Cluster Dummies
61
62  gen BUSINESS=0
63  replace BUSINESS = 1 if Cluster2=="Remote storage and file transfer & Artificial
    intelligence, data science, and analytics & Artificial intelligence, data science, and
    analytics & Other"
64
65  gen COM=0
66  replace COM = 1 if Cluster2=="Communication apps and tools"
67
68  gen PHYSIC=0
69  replace PHYSIC = 1 if Cluster2=="Physical goods and services"
70
```

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```
gen DIGI=0
replace DIGI = 1 if Cluster2=="Digital content & Home, well-being, and other personal needs"

gen ADVERT=0
replace ADVERT = 1 if Cluster2=="Advertising tools and platforms"

global clist COM PHYSIC DIGI ADVERT

// Cluster Final

gen cloud_infra=0
replace BUSINESS = 1 if Cluster3=="Remote storage and file transfer & Artificial intelligence, data science, and analytics & Other"

gen COMU=0
replace COMU = 1 if Cluster3=="Communication apps and tools"

gen PHYSICA=0
replace PHYSICA = 1 if Cluster3=="Physical goods and services"

gen DIGIT=0
replace DIGIT = 1 if Cluster3=="Digital content & Home, well-being, and other personal needs & Tools for developers"

gen ADVERTI=0
replace ADVERTI = 1 if Cluster3=="Advertising tools and platforms"

global flist COMU PHYSICA DIGIT ADVERTI

// Year Dummies

gen y15=0
replace y15 = 1 if Acquisitionyear==2015

gen y16=0
replace y16 = 1 if Acquisitionyear==2016

gen y17=0
replace y17 = 1 if Acquisitionyear==2017

gen y18=0
replace y18 = 1 if Acquisitionyear==2018

gen y19=0
replace y19 = 1 if Acquisitionyear==2019

gen y20=0
replace y20 = 1 if Acquisitionyear==2020

gen y21=0
replace y21 = 1 if Acquisitionyear==2021

global ylist y16 y17 y18 y19 y20
global zlist y16 y17 y18 y19 y20 y21

// US Dummy

gen US=.
replace US = 1 if USornonUS=="US"
replace US = 0 if USornonUS=="NON-US"


sum
tab Acquirer DISCON

// ESTIMATIONS 2015-2021

// Model 1

probit DISCON Age $alist $zlist, robust

eststo margin: margins, dydx(_cons Age GOOG AMZN FCBK APPL y16 y17 y18 y19 y20 y21) post
est sto m1

```

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```
143   // Model 2
144
145   probit DISCON Age $alist $zlist $flist, robust
146
147   eststo margin: margins, dydx(_cons Age GOOG AMZN FCBK APPL y16 y17 y18 y19 y20 y21 COMU
      PHYSICA DIGIT ADVERTI) post
148   est sto m2
149
150
151   // Model 3
152
153   probit DISCON Age $alist $zlist cloud_infra_dummy, robust
154   eststo margin: margins, dydx(_cons Age GOOG AMZN FCBK APPL y16 y17 y18 y19 y20 y21
      cloud_infra_dummy) post
155   est sto m3
156
157   // Model 4
158
159   probit DISCON Age $alist $zlist Main, robust
160   eststo margin: margins, dydx(_cons Age GOOG AMZN FCBK APPL y16 y17 y18 y19 y20 y21 Main)
      post
161   est sto m4
162
163   // Model 5
164
165   probit DISCON Age $alist $zlist funding_mill, robust
166   eststo margin: margins, dydx(_cons Age GOOG AMZN FCBK APPL y16 y17 y18 y19 y20 y21
      funding_mill) post
167   est sto m5
168
169   // Model 6
170
171   probit DISCON Age $alist $zlist US, robust
172   eststo margin: margins, dydx(_cons Age GOOG AMZN FCBK APPL y16 y17 y18 y19 y20 y21 US) post
173   est sto m6
174
175   // Model 7
176
177   probit DISCON Age $alist $zlist Active, robust
178
179   eststo margin: margins, dydx(_cons Age GOOG AMZN FCBK APPL y16 y17 y18 y19 y20 y21 Active)
       post
180   est sto m7
181
182
183   // Model 8
184
185   probit DISCON Age $alist $zlist $flist Main funding_mill US, robust
186
187   eststo margin: margins, dydx(_cons Age GOOG AMZN FCBK APPL y16 y17 y18 y19 y20 y21 COMU
      PHYSICA DIGIT ADVERTI Main funding_mill US) post
188   est sto m8
189
190
191   // Out put command
192
193   esttab m1 m2 m3 m4 m5 m6 m7 m8 using models-final-2015-2021_MT.tex, se star(* 0.1 ** 0.05
      *** 0.01)
194
195
196   // ESTIMATIONS 2015-2020
197
198   drop if y21==1
199
200   // Model 9
201
202   probit DISCON Age $alist $ylist, robust
203
204   eststo margin: margins, dydx(_cons Age GOOG AMZN FCBK APPL y16 y17 y18 y19 y20) post
205   est sto m9
206
207   // Model 10
208
209   probit DISCON Age $alist $ylist $flist, robust
210
```

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```
211   eststo margin: margins, dydx(_cons Age GOOG AMZN FCBK APPL y16 y17 y18 y19 y20 COMU
      PHYSICA DIGIT ADVERTI) post
212   est sto m10
213
214
215   // Model 11
216
217   probit DISCON Age $alist $ylist cloud_infra_dummy, robust
218   eststo margin: margins, dydx(_cons Age GOOG AMZN FCBK APPL y16 y17 y18 y19 y20
      cloud_infra_dummy) post
219   est sto m11
220
221   // Model 12
222
223   probit DISCON Age $alist $ylist Main, robust
224   eststo margin: margins, dydx(_cons Age GOOG AMZN FCBK APPL y16 y17 y18 y19 y20 Main) post
225   est sto m12
226
227   // Model 13
228
229   probit DISCON Age $alist $ylist funding_mill, robust
230   eststo margin: margins, dydx(_cons Age GOOG AMZN FCBK APPL y16 y17 y18 y19 y20
      funding_mill) post
231   est sto m13
232
233   // Model 14
234
235   probit DISCON Age $alist $ylist US, robust
236   eststo margin: margins, dydx(_cons Age GOOG AMZN FCBK APPL y16 y17 y18 y19 y20 US) post
237   est sto m14
238
239   // Model 15
240
241   probit DISCON Age $alist $ylist Active, robust
242
243   eststo margin: margins, dydx(_cons Age GOOG AMZN FCBK APPL y16 y17 y18 y19 y20 Active) post
244   est sto m15
245
246
247   // Model 16
248
249   probit DISCON Age $alist $ylist $flist Main funding_mill US, robust
250
251   eststo margin: margins, dydx(_cons Age GOOG AMZN FCBK APPL y16 y17 y18 y19 y20 COMU
      PHYSICA DIGIT ADVERTI Main funding_mill US) post
252   est sto m16
253
254
255   // Out put command
256
257   esttab m9 m10 m11 m12 m13 m14 m15 m16 using models-final-2015-2020_MT.tex, se star(* 0.1
      ** 0.05 *** 0.01)
258
259   log close
260   exit
261
```

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Executive Summary

Alphabet, Amazon, Meta, Apple, and Microsoft (GAFAM) are among the leading technology companies of the modern era. These market-leading positions enable them to make numerous mergers and acquisitions per year. For GAFAM alone, 329 mergers and acquisitions were identified in the analysed period from 2015 to 2021. In this context, there are growing concerns that leading market positions of large technology companies will be further expanded by anti-competitive practices related to this high merger activity. This thesis aims to determine how age, data and overlapping economic activities, as part of the merger and acquisition strategies, explain the dominant market positions of GAFAM. Additionally, the role of the origin and total funding of the acquired companies is examined in the context of these strategies. This involves finding out whether acquisitions of companies with certain characteristics may have anti-competitive motives.

In this paper, a retrospective analysis of GAFAM's merger and acquisition deals between 2015 and 2021 is conducted. In addition, the tech giants' decisions to shut down companies after the acquisition are examined. For this purpose, GAFAM and the companies they acquired are grouped into clusters based on their areas of economic activity. This aspect is taken into account in the review of their merger and acquisition strategies.

In most of the cases, the acquired firm is shut down after the acquisition. The results suggest that young companies or companies active in the field of cloud infrastructure prove to be more susceptible to shutdown decisions taken by GAFAM. This raises further concerns about the dominant position of GAFAM and potential anti-competitive motives at stake. Mergers and acquisitions may serve the purpose of eliminating the competitive threat posed by a young start-up company. Or they could be used to gain a strong advantage in cloud infrastructure that is used in an anti-competitive manner to further expand market power. Hence, the thesis proposes alarm signals for competition authorities to raise awareness of potential anti-competitive practices and ways to respond to them. This is not only relevant to mitigate anti-competitive behaviour by the five gatekeepers of the digital economy, but also by other large technology companies. An effective policy recommendation may help to reduce market power of large technology companies and related anti-competitive practices. Consequently, more companies may enter the market and compete with the incumbents, which stimulates innovation.

Word count = 18,216