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COVID-19 PANDEMIC MERGER WAVE

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COVID-19 PANDEMIC MERGER WAVE

A Master's Thesis

by

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COVID-19 PANDEMIC MERGER WAVE

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COVID-19 PANDEMIC MERGER WAVE

By Zeynep Ançel İlaslan

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Science in Finance.

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ABSTRACT

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This thesis investigates whether the Covid-19 pandemic initiated merger waves at the aggregate and industry level. Recovery from the Covid-19 pandemic coincides with economic expansion, industry shocks and stock market boom, all potential triggers of restructuring activity. My sample covers 104,464 merger and acquisition deals of public and private US target firms from April 1, 2012, to March 31, 2022. In order to identify industry-level merger waves, I simulate the distribution of monthly deals. I then calculate the probability that the realized peak deal concentrations in any 24-month period are within the 95th percentile of the simulated distributions. I identify an industry as experiencing a merger wave if the realized deal concentration in any 24-month period is in the upper five percent of the simulated distribution of monthly deals. The method yields 37 industry-level merger waves between April 1, 2012, to March 31, 2022. 23 of these waves start during the Covid-19 pandemic period from January 1, 2020, to March 31, 2022. Deals in industry-level merger waves comprised around 80 percent of all deals in the Covid-19 pandemic period and formed an aggregate merger wave that started on April 1, 2020.

Keywords: Covid-19, Merger Wave, Industry-shocks

ÖZET

Ancel Ilaslan, Zeynep

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Ağustos 2022

Bu tezde Covid-19 pandemisi sırasında sektör bazında birleşme ve satın alma dalgalarının kümelenmesiyle toplu bir birleşme satın alma dalgası başlayıp başlamadığı incelenmiştir. Covid-19 pandemisinin olumsuz etkilerinin düzelmesi ile ekonomik genişleme, sektör şokları ve borsada yükseliş eş zamanlıdır. Örneklemim 1 Nisan 2012 ile 31 Mart 2022 arasında gerçekleşen toplam 104.464 ABD menşeili halka açık ve özel şirketin hedef olduğu birleşme satınalma işlemini kapsamaktadır. Sektör bazında dalgaları saptamak için gerçekleşen aylık işlem sayıları on yıllık inceleme dönemi içinde rastgele aylara dağıtılarak simule edilmiştir. Simule ve gerçek dağılımdaki en yüksek iki yıllık konsantrasyonlar karşılaştırılmıştır. 50 sektörden 37'sinde inceleme dönemi içinde birleşme ve satınalma dalgası olduğu istatistiksel olarak gösterilmiştir. 37 sektör birleşme satınalma dalgasının 23'ü Covid-19 pandemi dönemi olarak tanımlanan 1 Ocak 2020 ile 31 Mart 2022 arasında gerçekleşmiştir. Bu sektörlerdeki işlemler Covid-19 pandemisi döneminde tüm işlem sayısının %80'ini oluşturmuş ve 1 Nisan 2020'de başlayan toplu bir birleşme satınalma dalgasına sebep olmuştur.

Anahtar Kelimeler: Covid-19, Birleşme Satınalma Dalgası, Sektör Şokları

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CHAPTER I: INTRODUCTION

This thesis investigates if Covid-19 pandemic coincides with industry-level and aggregate-level merger waves. Literature on determinants of merger waves is grouped into two: merger waves are either due to clustering of industry-level merger waves triggered by economic expansion and industry-shocks (Andrade et al., 2001; Gort, 1969; Harford, 2005; Martynova and Renneboog, 2005) or overvaluation due to stock market boom (Jovanovic and Rousseau, 2002; Shleifer & Vishny, 2003; Netter et al., 2011). An industry shock is any factor that changes the structure of an industry, including the number and size of firms (Mitchell and Mulherin, 1996). Deregulation, technological innovations, supply shocks, a sharp decrease in demand, volatility in input prices (Mitchell and Mulherin, 1996), sharp increase in demand (Gort, 1969) can trigger industry-shocks. Industry-shocks result in "large scale reallocation of assets" (Harford, 2005). Historically, industries don't fully recover from large adverse shocks, so reallocating capital and labor in industries is expected (Das et al., 2021). Reallocation of capital is possible with mergers & acquisitions (Jovanovic and Rousseau, 2001). Mergers and acquisitions concentrate in periods of economic recovery and result in merger waves (Martynova and Renneboog, 2005).

Chinese officials reported novel coronavirus for the first time on December 31, 2019, and the World Health Organization (WHO) announced Covid-19 as a pandemic on March 11, 2020. The pandemic caused industry shocks such as supply disruptions, a sharp decrease in demand, and volatile commodity prices (World Economic Outlook, April 2020). In terms of input prices, oil prices started increasing in April 2020, parallel to the recovery from Covid-19 pandemic and economic expansion. Recovery from the pandemic caused economic expansion. Global GDP growth rose 5.9% in 2021 from -3.3% in 2020. (Worldbank National Accounts Data, 2022). Covid-19

pandemic accelerated digitalization which came as a technology shock. This accelerated digitalization changed interaction with customers, suppliers and other stakeholders, and the relations with and between employees (Amankwah-Amoah et al., 2021). Regarding stock market movements, recovery from the adverse impacts of Covid-19 in US stock markets started in mid-March 2020 (Singh et al., 2020). US stock market indices exceeded their pre-pandemic values.

I hypothesize that the pandemic coincides with the clustering of industry-level merger waves that form an aggregate merger wave. The potential triggers of merger waves - economic expansion, industry shocks and stock market boom - coincided with the Covid-19 pandemic recovery period. The sample consists of 104,464 merger deals from Bloomberg covering the period from April 1, 2012, to March 31, 2022. I adopt the methodology of Harford (2005) to identify industry-level merger waves. The clustering of 16 industry-level merger waves initiates an aggregate merger wave that starts on April 1, 2020, and ends on March 31, 2022. The deals in industry-level merger waves comprise 80% of all deals from April 1, 2020, to March 31, 2022.

I contribute and extend the literature on merger waves. I use the method developed in Harford (2005) to identify and name a sixth aggregate merger wave that extends from April 1, 2020, to March 31, 2022. This aggregate merger wave is comprised of 16 industry-level waves. The start of 16 industry-level merger waves cluster in April 2020 and cause an aggregate merger wave.

The organization of the rest of the paper is as follows: In Chapter II, I discuss the literature review and testable hypothesis. In Chapter III and Chapter IV, I explain the sample and the methodology I use. In Chapter V, I present the results and conclude in Chapter VI.

CHAPTER II: LITERATURE REVIEW AND TESTABLE HYPOTHESIS

2.1 What Is a Merger Wave?

A merger wave is a clustering of successful takeover bids at the industry or economy-wide level in a certain period (Betton et al., 2008).

There is literature on defining merger waves by statistical properties. Shughart and Tollison (1984) state that no statistical properties define a merger wave. The authors used US deal data (total annual number of deals and total annual value in dollars) from 1895 to 1979. They concluded that using the ordinary least squares test, the number and value of deals follow a white-noise process (the series follow a random walk, with no dependence between following years). Golbe and White (1993) formally tested whether a particular time series pattern of mergers exists. The authors collected the annual number of US deals data from various sources covering 1895 to 1989. The average number of deals was significantly lower than the number of deals in peak years within the analysis period. The authors used regression analysis on the time-series deal data, and the variable representing the amplitude of a sine wave was statistically significant, proving that sine curves fit in the data and mergers came in waves. Town (1992) states that waves characterize merger time series. He defines a merger wave as a period of very intense merger activity with a "large, discrete, unsustainable increase" and the other periods as a normal merger activity state. Hamilton (1989) developed a model to analyze the recurrent pattern of increases and decreases in business cycles. Town (1992) uses this model to capture the structure of merger and acquisition (M&A) time series data (number of deals from 1895 to 1989 in the US). He criticizes Shughart and Tollison (1984) and Golbe and White (1993) as the authors try to fit historical M&A data into a specific model. Town (1992) states that mergers move between two states: high mean and high variance to low mean and low variance. Gartner and Halbheer (2009) define

merger waves as a wave-like pattern in merger activity. They agree on the existence of waves as in Town (1992) and Golbe and White (1993). They use a refined version of the same method -the Markov regime-switching model - with Town (1992) with a different period; 1973 to 2003 for US.

Contrary to Town's work (1992), Gartner and Halbheer (2009) did not identify a wave in the 1980s, and the wave identified in the 1980s by Town is mainly due to a methodological difference. All the authors mentioned above “calculated the probability of a high-activity state while holding the model parameters fixed at their maximum likelihood estimate". However, Gartner and Halbheer (2009) followed the iterative Gibbs sampling approach to infer the conditional distribution more accurately.

Mitchell and Mulherin (1996) and Harford (2005) focus on industry-level waves rather than the aggregate level. Mitchell and Mulherin (1996) use chi-square tests to determine if the inter-industry variation between industry takeover rates is significant as they hypothesize that industry-shocks drive merger waves. Then, they simulate probability distributions of takeover data and compute the probability of observing the actual distribution from 1982 to 1989. Harford (2005) simulates the probability distributions of takeover data and computes the probability of observing the actual distribution between 1981 and 2000.

Table 1 Summary of Literature on Existence of Merger Waves

Paper	Sample	Method	Results
Shughart and Tollison (1984)	Number and $ value of US deals 1895 - 1979	Autoregressive process	Merger waves don't exist
Town (1992)	Number of deals in US and UK 1895 - 1989	Markov regime-switching model	Merger waves exist
Golbe and White (1993)	Number and $ value of US deals 1895 - 1989	Sine curve estimation, regression analysis	Merger waves exist
Gartner and Halbheer (2009)	Number of deals in US and UK 1973 - 2003	Markov regime-switching model	Merger waves exist
Mitchell and Mulherin (1996)	Number of deals in US of firms listed in Value Line 1982 - 1989	Simulating probability distributions	Merger waves exist and differ by industry
Harford (2005)	Number of deals with deal value over $50 million in US 1973 - 2003	Simulating probability distributions	Merger waves exist and differ by industry

2.2 Past Waves

Town (1992) uses Hamilton's (1989) model to identify four significant waves that lasted over two years and five minor merger waves. Major waves are between 1898 – 1902, 1919 – 1921, 1925 – 1932, and 1967 – 1969. Using sine curve estimation, Golbe and White (1993) identified four peak years of merger activity, 1898, 1928, 1959 and 1989. Gaertner and Halbheer (2009) analyzed 1973 – 2003 and stated there was no wave in the 1980s. There was only one significant wave in US after 1973, starting in 1995. Mitchell and Mulherin (1996) identified waves by industry in the 1980s. Initial years differed by industry but cluster in 1985 – 1986.

Other scholars focused on the coinciding events and determinants of specific waves, waves that represent periods of high activity and firm disappearances (Rhodes-Kropf and Viswanathan, 2004). Nelson (1959) analyzed the wave from 1895 to 1905, Eis (1969) focused on the 1920s, Schleifer and Vishny on the 1960s and 1980s (1991) and Betton et al. on the 1990s (2008). The four significant waves are of the late 1890s, late 1920s, late 1960s and late 1980s, according to Golbe and White (1993). The fifth wave is a global one and started in 1993 (Gregoriu and Renneboog, 2007).

Nelson (1959) states the period of the first merger wave to be from 1895 to 1905. The author connects it to the growth in industrial production and significant increases in stock prices. Industries with higher growth rates in production had higher merger activity. This period also coincides with the development of a large-scale, organized capital market where the number of shares traded peaked. They tested the relation between merger activity and stock prices and concluded that merger activity between 1895 – 1904 shows a positive relationship to stock price changes after controlling for production level changes. The authors state that in years of peak merger activity, movements in stock prices are more important than changes in industrial production. US industry consolidated with mergers from 1895

to 1904. 85-95% of the industry consolidated with this merger wave (Bittlingmayer, 1985).

Eis (1969) focuses on the second merger wave following World War I in the 1920s. Transactions concentrated in a few industries; primary metals, petroleum refining and related products, food and kindred products, chemicals and allied products and transportation equipment. Takeovers were mainly in the form of horizontal mergers comprising 50% of all transactions. The food and dairy industries consolidated, and the result of the merger wave was a shift towards an oligopolistic structure in these industries. Monopolies were formed in the first wave. The dominant firm didn't try to increase its market share via mergers in the second wave. However, smaller firms formed larger firms to compete with the dominant firms.

Shleifer and Vishny (1991) state that large corporate cash flows and high valuations of stocks coupled with managers' reluctance to distribute dividends caused the third merger wave in the 1960s. Acquirers preferred to bid on companies outside their main line of business due to strict antitrust regulations and usually paid by stock due to overvaluation. The ratio of conglomerates in the economy rose from 7% to 18%. The acquisitions diversified the businesses of the merging parties. Managers also believed that diversification offered information advantages in capital budgeting and allocation. Diversification also contributed to forming an internal capital market (Hubbard and Palia, 1999). Although the stock market response was positive, diversification didn't turn out to be very profitable, and the trend reversed to divestitures in the 1970s.

With the deregulation of antitrust policy, the '80s merger wave reversed the diversification trend of the 1960s (Shleifer and Vishny, 1991). In this fourth merger wave, many transactions were hostile. 28% of Fortune 500 companies were acquired by another in this period. Method of payment was usually cash. Stock market response was again positive to acquisition of related targets. Financial innovations such as junk bonds and bridge loans helped increase the number of transactions (Ravenscraft, 1987).

Betton et al. (2008) and Gregoriu and Renneboog (2007) identify the fifth wave as a global wave that occurred in the late 1990s. Cross-border transactions with global strategic partners characterize this wave. Takeovers in related industries (horizontal or vertical) were dominant. Mega deals were apparent in the USA, Continental Europe, United Kingdom (UK) and Asia. Hostile takeovers in the USA in the 80's wave became common in Continental Europe during this wave (Gaughan, 2000).

Table 2 Summary of Literature on Past Merger Waves

Merger Wave	Period	Authors	Determinants	Results
First wave	1890s	Nelson (1959), Town (1992), Golbe and White (1993)	Growth in industrial production and significant increases in stock prices	Industry consolidation resulting in monopolies
Second wave	1920s	Eis (1969), Town (1992), Golbe and White (1993)	High growth in industrial production of food, metals and petroluem industries	Industry consolidation resulting in oligopolies
Third wave	1960s	Shleifer and Vishny (1991), Town (1992), Golbe and White (1993)	Large corporate cash flows, high valuations of stocks and strict antitrust regulations	Conglomerates
Fourth wave	1980s	Ravenscraft (1987), Shleifer and Vishny (1991), Golbe and White (1993), Mitchell and Mulherin (1996)	Financial innovations, poor performance of conglomerates	Reversed diversification
Fifth wave	1990s	Gaughan (2000), Gregoriu and Renneboog (2007), Betton et al. (2008)	Globalization	Mega deals

2.3 Determinants of Merger Waves

There are some common characteristics of merger waves. The beginning of all five waves coincides with economic recovery/expansion. In addition, one or more of the following changes defined as industrial shocks were in place: technological innovation in industrial processes, technological progress in electronics, deregulation of financial sector services, new financial instruments, strengthened application or deregulation of antitrust laws, new state legislations on incorporations, privatizations (Martynova and Renneboog, 2008), volatility in input prices (Mitchell and Mulherin, 1996). I group the triggers of merger waves in two: economic expansion/industry shocks and overvaluation due to the stock market boom.

2.3.1 Economic Expansion & Industry-Shocks

Gort (1969) states there is variation in the merger rates between industries during merger waves. This variation can't be explained by hubris or tax incentives. According to Gort (1969), firms acquire when there is a discrepancy between the owner's and investor's firm valuation. This discrepancy in valuation increases in times of rapid changes in technology and security prices. In addition, economic expansion pushes firms to increase capacity, and mergers are cheaper than establishing new facilities. Therefore, industry growth triggers mergers. Gorton et al. (2005) state that mergers concentrate in industries with technological or regulatory changes. Mitchell and Mulherin (1996) state that merger waves occur due to industry shocks and they cluster at the industry level. They define industry shocks as significant changes in technology, government policy, input prices and demand and supply conditions. I explain Industry shocks further below.

2.3.1.1 Technological Shocks

A technological shock is one that "rearranges comparative advantage". Technological shocks require the reallocation of assets (Jovanovic & Rousseau, 2001). Firm sizes

increase following technological shocks, and mergers are the least costly way (Mitchell and Mulherin, 1996). Examples of technological shocks are innovations such as electricity, internal combustion engine in the 20th century, microprocessors and information technology in the 21st century. Usually, new players bring in revolutionary technologies like electricity by GE and Westinghouse and microcomputers by Apple and Microsoft (Jovanovic and Rousseau, 2001).

Andrade et al. (2001) state high Q firms acquire lower Q firms. James Tobin (1969) introduced the Q theory. It is the ratio of the firm's market value to the replacement cost of its assets. When a firm's Q increases, its market value increases relative to its assets. From 1973 to 1998, for around 2/3 of all deals, the acquirer's Q was higher than the target's Q. Jovanovic and Rousseau (2002) extend the Q theory of investment into a theory of merger waves. Prevailing high Q signals the overvaluation of a stock. The authors explain that the merger waves of the 1900s, 1920s, 1980s and 1990s were due to reallocation opportunities caused by technological change when the dispersion between high Q and low Q firms was high. Well-managed companies with high Qs increased their merger activity and acquired low Q companies.

2.3.1.2 Government Policy

Antitrust policy affects the frequency of mergers. Deregulation that affects mergers include deregulation of entry, exit, price and quantity (Ovtchinnikov, 2013). According to Bittlingmayer (1985), the first merger wave is triggered by deregulation. Firms prefer cartels to mergers if the gains are more significant. When the government introduces a law against price fixing, firms prefer to merge (Bittlingmayer, 1985). Andrade et al. (2001) focused on 1973 to 1999 US domestic acquisitions. Mergers in the 1990s were different from the 1980s as the dominant method of payment was stocks. However, the two waves were similar in that the level of takeover activity between industries differed significantly. Deregulation played a part. Industries with deregulation such as airlines, broadcasting,

entertainment, natural gas, trucking, banks and thrifts, utilities and telecommunications accounted for more than half of deal volume.

Mitchell and Mulherin (1996) identified merger waves by industry. Half of the deal volume in dollar terms during 1985 - 1986 concentrated in 7 industries out of 50. Deregulation had a significant impact on these industries. The authors' regression analysis showed that deregulation had a significant effect on initiating industry-level merger waves.

On the other hand, a wave may occur after government eases antitrust policy, but the relationship is not causal. Both mergers and government policy change respond to technological change (Jovanovic and Rousseau, 2001), and the policy becomes a tool when technology is stable. Ovtchinnikov (2013) states that deregulation results from industry performance and is an endogenous shock. Deregulation in industries follows poor industry performance; therefore, factors preceding deregulation also predict merger waves. The author empirically shows that deregulation is not a significant variable that triggers merger waves. I don't include deregulation in industry shocks for the remainder of the study.

2.3.1.3 Input Prices

Jensen (1993) suggests input price shocks, especially a ten-fold increase in oil prices, triggered mergers in many industries in the 1980s. Mitchell and Mulherin (1996) classified industries based on energy dependence. The authors assign a proxy variable – energy dependence – which equals 1 when energy comprises more than 10% of an industry's input Those industries that were highly dependent on energy had merger waves in times of volatility in energy prices. The authors' regression analysis showed that energy dependence had a significant effect on initiating industry-level merger waves, but it didn't have explanatory power on the variation of takeovers between industries in the 1980s wave.

2.3.1.4 Demand and Supply Shocks

The decline in demand due to shocks results in industry players closing down some facilities or merging (Mitchell and Mulherin, 1996). The authors capture the impact of supply by using a proxy in their analysis, import vulnerability. Industries are ranked by the percentage increase in imports, the ones in top third are considered one for this dummy variable. This variable did not have a significant impact. The authors did not have a variable to test the impact of demand.

Harford (2005) states growth in demand and profitability precedes merger waves. The author divides factors that may trigger merger waves into two: behavioral and neoclassical. Harford (2005) considers the impact of economic expansion on industries as industry shocks. The impact of economic, regulatory and technological shocks is visible in variables suggested by neoclassical theory. Of neoclassical variables, empirical study shows that deregulation and economic shock index representing net income/sales are significant in predicting merger waves among neo-classical variables. His univariate analysis shows that in years preceding merger waves, industries with waves show abnormally high-performance contradicting Mitchell & Mulherin (1996).

Maksimovic and Philips (2000) hypothesize that when a positive demand shock affects peripheral assets, these assets are acquired by more efficient firms. Acquirer benefits more from the asset and the increased capacity. When a positive demand shock affects the main division of the firm, the firm will sell peripheral assets. Sales in multi-segment firms follow a pattern related to productivity differences between segments. Their findings suggest that resources are allocated more efficiently through the sale of plants, assets and firms.

Throughout the rest of the paper, I assume an industry-shock is due to major changes in demand (Gort, 1969; Harford, 2005; Maksimovic and Phillips, 2000; Harford, 2005), changes in supply (Mitchell and Mulherin, 1996), volatility in input prices (Jensen, 1993; Mitchell and Mulherin, 1996), availability of capital liquidity

(Harford, 2005) and technology shocks (Gort, 1969; Jovanovic and Rousseau, 2001). I don't include government antitrust policy and deregulation as they follow business changes, not precede them (Jovanovic and Rousseau, 2001; Ovtchinnikov, 2013).

2.3.2 Pricing/Information Asymmetry, Stock Market Boom

Schleifer and Vishny (2003) hypothesize that stock market valuations of merging firms trigger mergers. The authors assume financial markets are inefficient while managers are rational. Managers take advantage of the inefficiencies through mergers. Managers know their shares are overvalued and participate in mergers using their stock before the stock price decreases. Rhodes-Kropf and Viswanathan's (2004) theoretic model suggests that managers of acquirer firms have private information about the target's and firm's actual value. Managers of target firms have private information on their firm's value, so their decision to sell is based on the possible synergy. When the stock market is overvalued, synergies are overvalued and the relatively undervalued targets are more likely to sell. So, the authors suggest merger waves can occur solely because of valuation issues in the stock market. Gugler et al. (2012), hypothesize that mergers occur during stock booms since the optimism in capital markets weakens the constraints on managers' decision-making powers, allowing them to participate in wealth-destroying mergers. They analyze merger data of Continental Europe, United Kingdom and USA from 1991 to 2004. If merger waves are due to industry-shocks, listed and unlisted firms should be affected, however, waves were exclusive to listed companies showing that stock market bubbles drive merger waves. Thakor and Goel (2009) state that economic expansion periods and bull markets increase discrepancy in valuation and discrepancy in CEO compensation triggering merger waves. In any industry, CEOs' envy of each other's compensation -determined based on firm size- encourages them to acquire other firms even when the merger is value dissipating, creating a wave. The effect is visible in the increased disparity between firms' market capitalization and the differences in returns between early acquirers and late acquirers within a wave. They hypothesize that within the earlier period of a wave, targets are smaller, bidder returns are higher, increase in CEO compensation as a

result of the merger is higher. Their analysis is based on a sample of public firms listed on the S&P 500. Cornett et al. (2011) state managers may decide to participate in mergers because their competitors do. In addition, a firm is more likely to participate in a deal if the firm was a target or a bidder in a merger deal in the last 2 years. They test the determinants of merger anticipation including the variables dormant period that represents the months passed over the last deal in the industry and previous mergers which shows the number of deals a firm participated in, both variables are significant in estimating bidder and target candidacy in a merger. Therefore, when a firm participates in a merger transaction, it is more likely to participate again in two years and when the industry had merger transactions recently, firms in an industry are more likely to be involved in a transaction.

Harford (2005) tests the impact of stock market boom, overvaluation and increased synergy on merger waves. As behavioral variables representing stock market movements, he uses the mean of industry compounded three-year and one-year median market returns, mean of industry median standard deviation in three-year market returns, mean of industry median Market to Book Ratio for all industry years of 28 industries. However, the empirical analysis shows that behavioral variables' impact is not significant.

Table 3 Literature on Determinants of Merger Waves

Paper	Sample	Method	Results
Gort 1969	US manufacturing deals with deal values above $500,000 1951 - 1959 compiled from US Federal Trade Commission	Regression analysis	Mergers cluster by industry and result in merger waves and coincide with times of high level of technical personnel ratio, productivity change, industry growth and concentration in the industry*
Bittlingmayer 1985	US and UK deals 1890 - 1905	Regression analysis	Frequency of mergers increase with antitrust policy/when price fixing is not possible and the ultimate aim is to form monopolies
Mitchell and Mulherin 1996	Number of deals in US of firms listed in Value Line 1982 - 1989	Regression analysis	Volatility in input prices and deregulation trigger merger waves
Maksimovic and Phillips 2000	US manufacturing firm deals 1974 - 1992	Regression analysis	Firm size and industry returns to scale are correlated with frequency of mergers
Jovanovic and Rousseau 2001	US public firm deals listed in CRSP and Compustat	Correlation and regression analysis	Merger waves coincide with periods of high Q dispersion among firms
Andrade, Mitchell and Stafford 2001	US deals listed in CRSP of public firms 1973 - 1998	Regression analysis	Deregulation is a factor in triggering industry level merger waves
Jovanovic and Rousseau 2002	US deals available in prior research 1885 - 1998	Correlation	Technology shocks drive merger waves
Shleifer, Vishny 2003	Theory paper	No empirical test	Misvaluation has significant effect on mergers and merger waves
Rhodes-Kropf and Viswanathan 2004	Theory paper	No empirical test	Misvaluation has significant effect on mergers and merger waves

Paper	Sample	Method	Results
Harford 2005	US deals with deal value over $50 million 1973 -2003	Regression analysis	Industry-shocks cause industry level and aggregate merger waves if there is sufficient capital liquidity
Gorton, Kahl and Rosen 2005	Theory paper	No empirical test	Firms merge, and merger waves occur since managers want to increase the firm size and remain independent in times of regulatory and technological change
Goel and Thakor 2009	US deals with deal value over $2 million 1979 -2006	Regression analysis	Mergers are realized due to envy of managers, earlier deals in waves are smaller with higher CARs
Netter, Stegemoller and Wintoki 2011	All deals 1992 2009 from SDC and CRSP	Descriptive analysis, simulating probability distributions	Merger waves are not visible when the sample doesn't include deal size, country and public/private filters
Gugler, Mueller and Weichselbaumer 2012	Austria, Germany, Italy, France, UK and US deals with deal value over $1 million from TFSD 1978 – 2005	Regression analysis	Merger waves coincide with stock market booms
Ovtchinnikov 2013	US deals on CRSP of firms with asset value over $10 million 1980 – 2008	Regression analysis	Industry level merger waves coincide with deregulation, while deregulation follows periods of poor performance or supply/demand shocks in industries. Mergers following deregulation are exits

*Ratio of output by four largest producers to total industry

2.4 Covid-19 Related Shocks in the US Economy

Covid-19 had an unprecedented impact on the US economy. Its long-run impact can't be compared to previous natural disasters or armed conflicts (Jorda et al., 2020). Its impact isn’t uniform across industries.

2.4.1 Technological Shocks

Technological shocks are one of the determinants of merger waves. Covid-19 changed the nature of work significantly with telework and digitization (Amoah et al., 2021). Bloomberg (2018) defines digitization as converting analog or paper-based information and processes to digital form accessible by computers and digitalization as "the use of digital technologies to change a business model and provide new revenue and value-producing opportunities". Digitalization brings business model innovations. Changes in business models are " changes in a company's business model that is new to the firm and results in observable changes in its practice towards customers and partners" (Rachinger et al., 2018). Covid-19 acted as a “great accelerator” in embracing technological trends such as “video telephony, 5G digital networks, Internet of Things, cloud computing, machine learning and artificial intelligence” (Amoah et. al, 2021). The pandemic encouraged the adoption of information technology tools and changed "the nature of work, training, hiring, delivering content and education during the pandemic" (Khlystovaet al., 2022).

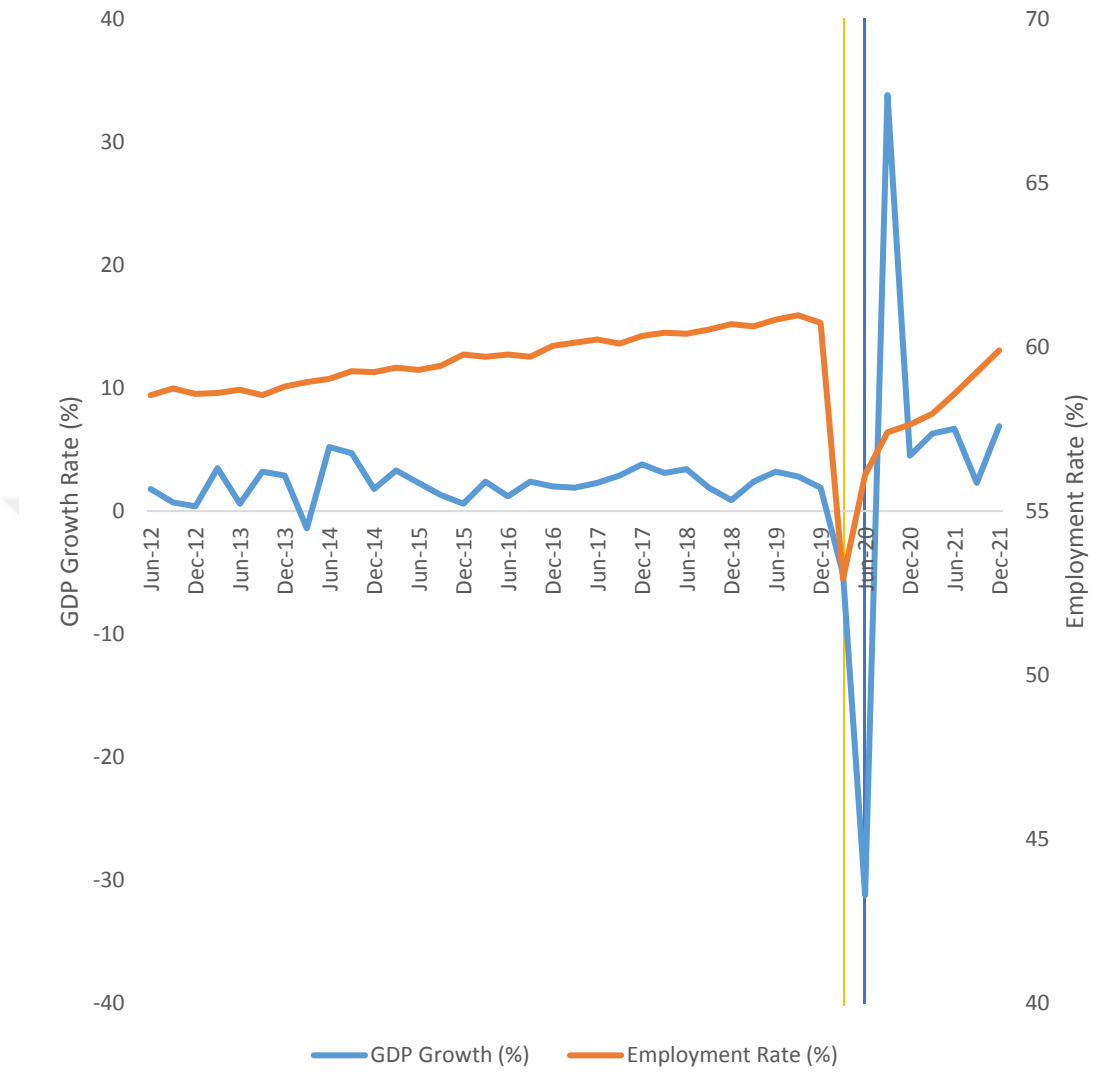
Technology shocks change industry demand and supply. According to Basu et al. (2013), technology shocks impact investment and consumption. Both impacts are visible on the industry's output, consumption, investment, and hours worked. Holly and Petrella (2012) show that technology shocks increase output and hours worked. Therefore, the impact of technological shocks can be observed in macroeconomic expansion and industry-level output.

According to McKinsey (2020), retail, healthcare, pharmaceuticals, and financial services are most affected industries during Covid-19 pandemic. Growth at industry level and total revenue of public firms are presented in Table 4.

2.4.2 Impact on Demand and Supply

Economic expansion is a determinant of merger waves and recovery from Covid-19 impacted economic growth (Mitchell & Mulherin, 1996; Harford, 2005; Thakor and Goel; 2009). Economy-wide demand and supply changes are represented by Gross Domestic Product (GDP) and employment. The growth in GDP and employment for the period under analysis is in Figure 1.

Figure 1 Quarterly GDP Growth Rate and Employment Rate April 2012 – March 2022



Source: Federal Reserve Economic Data (FRED) and US Bureau of Labor Statistics

GDP Percent Change at Annual Rate, Quarterly, Seasonally Adjusted Annual Rate

Quarterly Seasonally Adjusted Average Employment-Population Ratio

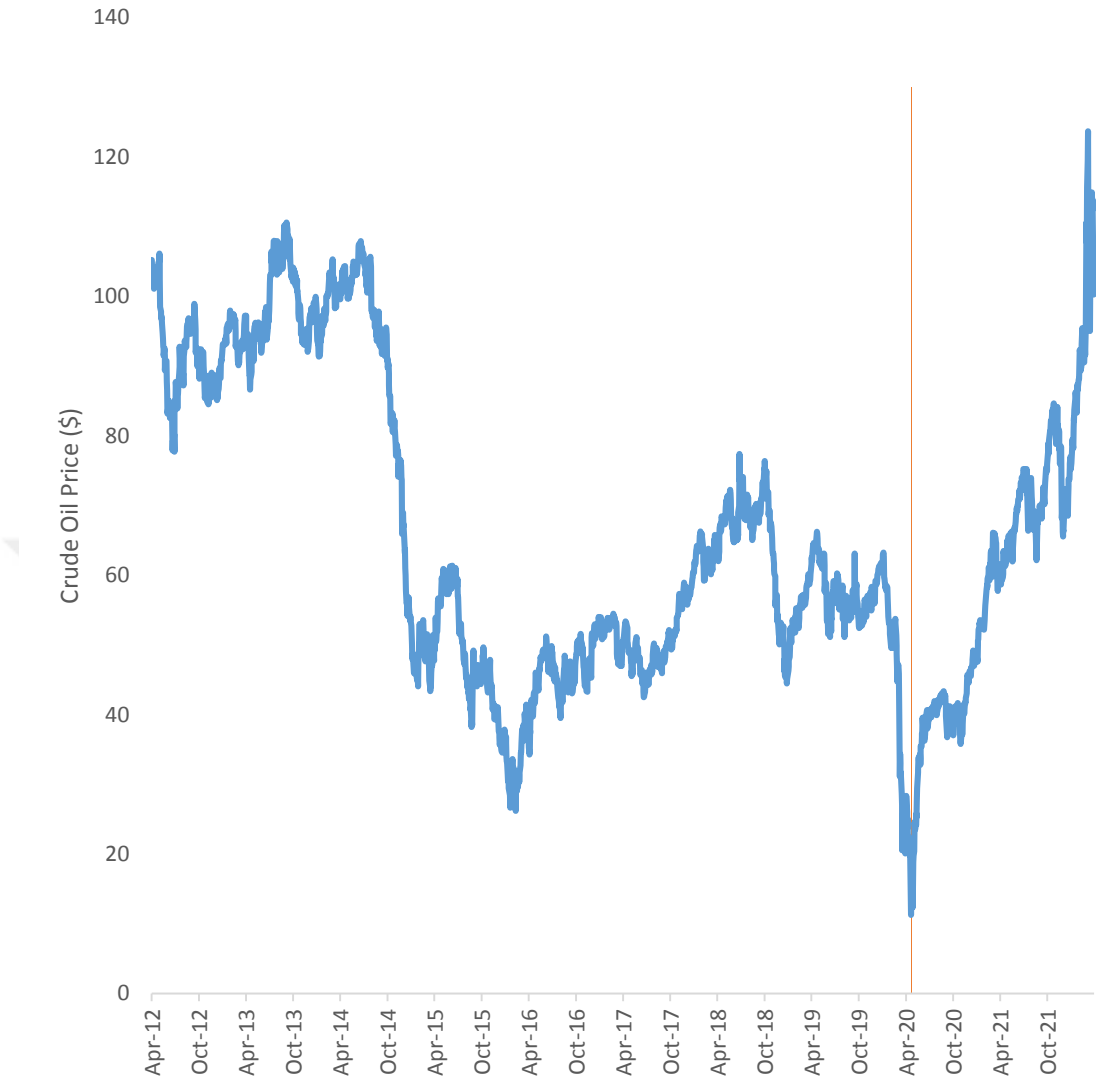
Regarding industry-level demand and supply, industry-level sales and employment data for all US firms are unavailable for 2020 and 2021 as of the date of this thesis. However, sales and profitability of firms listed on S&P 500 Index, NYSE American Composite Index, NASDAQ Composite Index, Dow Jones Industrial Average, Wilshire 5000 Total Market Index, Russell 2000 Index and Nasdaq-100 Index are available. U.S Securities and Exchange Commission (SEC) state that these indices cover all sectors of the economy and stock market. I use S&P 500 Index, NYSE American Composite Index, NASDAQ Composite Index, and Dow Jones Industrial Average for industry level sales and profitability as these are available in my data source, Bloomberg. Industry-level employment is not available.

I present the adverse effect of Covid-19 on demand and supply proxied by revenue and profitability growth of public firms by industry. Appendix C shows that on March 31, 2020, median revenue growth for the last 12 months for all industries was -36%, and median profitability growth was 1%. While most industries show negative revenue growth, there is significant dispersion between industries. Real Estate, Aerospace & Defense, Building Materials, Renewable Energy, Agriculture & Food, Leisure Time Products and Engineering & Construction industries showed positive growth in the same period.

2.4.3 Input Prices

Fluctuations in oil prices are one of the shocks that cause merger waves (Jensen, 1993; Mitchell and Mulherin, 1996; Andrade, 2001). Oil prices fluctuated significantly during the pandemic. Figure 2 shows the trend of oil prices from April 1, 2012, to March 31, 2022. Oil is a significant input to production. Therefore, oil price fluctuations impact firms' cash flow and profitability (Tuna and Tuna, 2022). Figure 2 shows crude oil prices from April 1, 2012 to March 31, 2022.

Figure 2 Oil Prices* ($) April 2012 - March 2022



Source: macrotrends.net

*West Texas Intermediate (WTI or NYMEX) crude oil prices in $ per barrel adjusted for inflation using Consumer Price Index (CPI).

Mitchell and Mulherin (1996) constructed a dummy variable for industries with higher than 10% energy dependence. Highly energy-dependent industries are most impacted by volatility in energy prices and are more likely to have industry-level merger waves following the volatility in energy prices. The first three columns in Table 3 are from Mitchell and Mulherin's (1996) study, the last column shows the related industries of my sample. Table 3 shows that the most energy-dependent industries are Healthcare-Services, Computers, Electronics, Semiconductors, Home Furnishings/Office Furnishings, Office&Business Equipment, Industrial Support Services, Diversified Machinery, Entertainment Content, Food, Aerospace/Defense, Airlines, Household Products/Wares, Apparel and Broadcasting.

Table 4 Energy Dependent Industries

Value Line Industry (VLI)	**Input - Output Industry**	**Energy fraction as % of total inputs**	**BICS Related Industries**
Mfg. Housing & rec. Vehicles	Mobile homes	72	n.a
Medical Services	Hospitals	71	Healthcare - Services
Computer Data Processing	Electronic Computing Equipment	69	Computers, Electronics, Semiconductors
Office equipment & supplies	Office, computing & accounting machines	66	Computers, Electronics, Home Furnishings, Office Furnishings, Office/Business Equip
Industrial Services	Other business services	65	Industrial Support Services
Machinery	General industrial machinery & equipment	63	Machinery-Diversified

Value Line Industry (VLI)	Input - Output Industry	Energy fraction as % of total inputs	BICS Related Industries
Entertainment	Motion pictures	57	Entertainment Content (Media)
Food Processing	Food & kindred products	50	Food
Aerospace & Defense	Aircraft	48	Aerospace/Defense, Airlines
Electronics	Electronic components & accessories	43	Electronics
Construction Machinery	Construction machinery & equipment	43	Machinery-Constr&Mining
Fast Food & Restaurants	Eating & drinking places	36	Food Service
Home Appliances	Household appliances	25	Home Furnishings, Office Furnishings, Office/Business Equip
Shoes	Shoes, except rubber	21	Apparel
Broadcasting	Radio & TV Broadcasting	11	Broadcasting (Media)

Since Mitchell & Mulherin's study in 1996, energy consumption by industries changed significantly. According to U.S Energy Information Administration (EIA) service industries comprise a small portion (14%) of total energy consumption. Transportation comprises 27%, while manufacturing comprises 30%. Energy-

intensive manufacturing industries are Food (Food, Beverage, Tobacco), Pulp and Paper (Paper manufacturing, Printing), Chemicals, Refining, Iron and Steel, Metals and Non-Metallic Minerals (EIA, 2018). These energy-intensive industries, excluding Food industry recorded decreases of more than 80% in their revenues from April 1, 2019, to March 31, 2020.

2.4.4 Stock Market Movements

The stock market boom increases overvaluation and increases the dispersion between buyer and seller's valuation and synergy, resulting in merger waves (Gort, 1969; Andrade et al., 2001; Shleifer and Vishny, 2003; Rhodes-Kropf and Viswanathan, 2004; Thakor and Goel, 2009; Gugler, 2012). Stock market indices peaked with the recovery from Covid-19.

Wilshire Stock Index covers all US equities and reflects the movements of the whole stock market in the US with around 3,700 equities as of 2021-year end. Figure 3 represents Wilshire Stock Index. The index value decreased in March 2020. Recovery started in April 2020 and index value reached unprecedented values in the last quarter of 2021.

Figure 3 Wilshire Stock Index April 2012 – March 2022

Source: Bloomberg

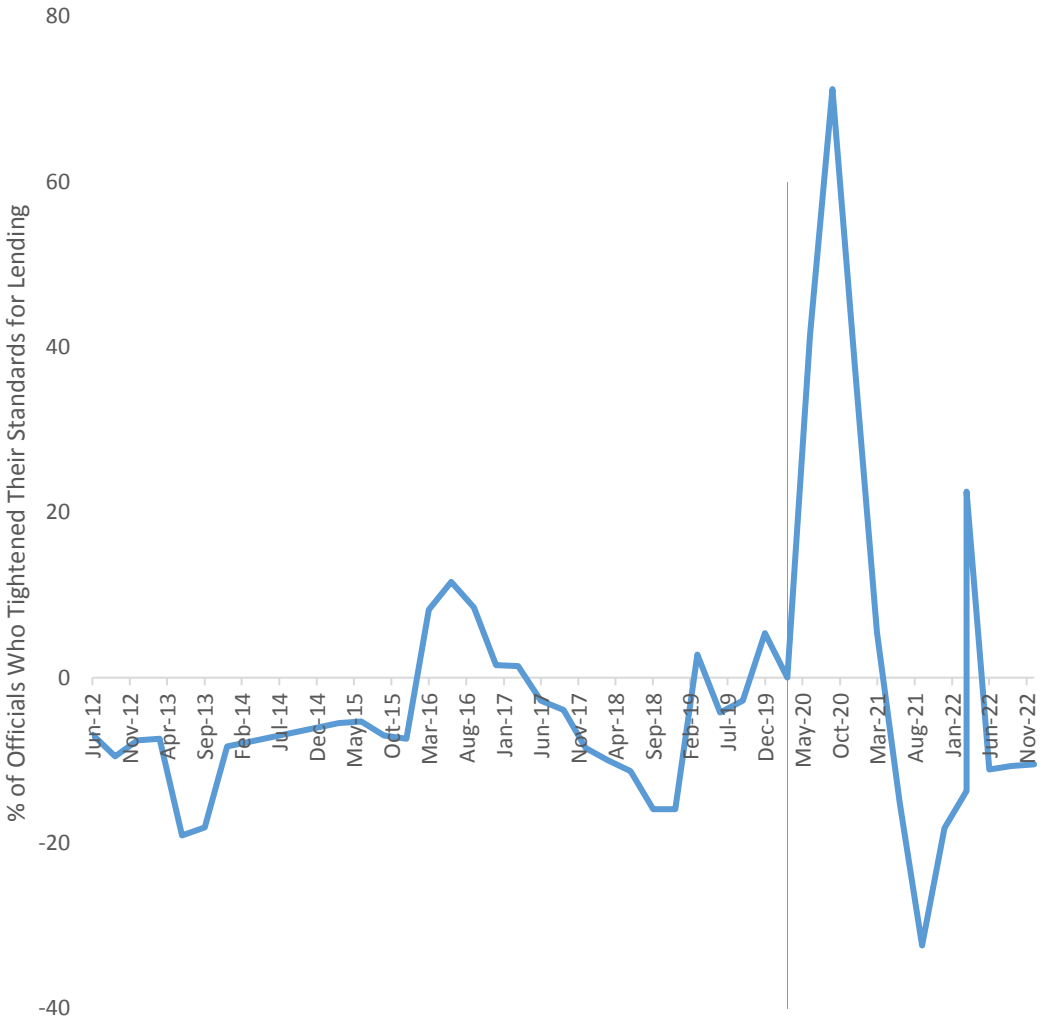
Index, not seasonally adjusted quarterly average

Harford (2005) uses one-year and three-year returns by industry and their dispersions to measure the impact of stock market valuation on merger waves. Historical dispersions and three-year returns are not available on Bloomberg. Appendix D shows one-year return and Price to Book (P/B) Ratios by industry on March 31, 2020, ranked by P/B.

2.4.5 Liquidity Shocks and Credit Constraints

Shleifer and Vishny (1991) emphasized that the availability of capital liquidity is critical for merger waves. Lown et al. (2000) state that Senior Loan Officer's (SLO) Survey Results and commercial output are strongly correlated and that Federal Reserve's (FED) SLO Survey can be used to forecast commercial loan growth. Harford (2005) use the spread between the average rate for commercial and industrial loans and federal funding rates to represent the overall availability of capital liquidity in the economy. Harford advises using SLO Survey data, but it wasn't available for the period under analysis. SLO Survey is published quarterly by the FED. It covers up to eighty large domestic banks and twenty-four US branches and agencies of foreign banks (FED, 2022). The question is 'whether they had tightened or eased credit standards for commercial lending over the past quarter. SLO Survey data is available for 2012 – 2022. Figure 4 shows the results of SLO Survey for April 2012 – March 2022. In Figure 4, when the line is below zero, lending standards become less tight and capital liquidity becomes more available. Banks tightened their credit standards from April 1, 2020, to March 30, 2021.

Figure 4 Senior Loan Officer's Survey Results



2.5 Hypothesis Development

H_0: Covid-19 didn't trigger a merger wave.

The start of the past five merger waves in literature coincide with technology shock that changed business models, stock market boom, economic expansion, industry-shocks, volatility in input prices coupled with availability of capital liquidity. Covid-19 pandemic is an exogenous shock that affected industries differently and caused industry shocks. Recovery from the pandemic started in April 2020, parallel with the increase in stock prices, economic expansion and a sharp increase in oil prices. Considering that the determinants of merger waves existed in the pandemic period and that the impact of each of these factors wasn't uniform among industries, I hypothesize that the exogenous shock of Covid-19 pandemic triggered an aggregate merger wave comprised of industry-level merger waves.

H_1: Covid-19 pandemic coincided with an aggregate-level merger wave with the clustering of industry-level merger waves.

CHAPTER III: SAMPLING FRAMEWORK

I draw the sample of M&A deals of US targets with announcements ranging from April 1, 2012, to March 31, 2022, using Bloomberg database. I adapt the sampling strategy described in Harford (2005) to compile the sample of M&A deals.

Harford's (2005) sample includes completed M&A deals with deal value over 50 million dollar with US acquirers. Andrade et al. (2001), Gort (1969), Goel and Thakor (2009), Maksimovic and Phillips (2000) use deals with announced deal values. Most deals with announced deal values are of public firms. Mitchell & Mulherin (1996) and Harford (2005) use deals with US public firms in their samples. Total value of deals as a measure of merger activity is subject to errors since, in most deals, the value is not disclosed (Town, 1992; Netter et al., 2011). Therefore, I use all deals whether the deal value is disclosed or not.

I analyze one decade of announced deals using the Bloomberg database. I cover deals with proposed, pending and completed status on Bloomberg instead of only completed deals and exclude withdrawn and terminated deals. Choosing only completed deals would result in underestimating the takeover rate for the first quarter of 2022. I start with all announced M&A type deals announced between April 1, 2012, to March 31 2022. The filter results in 471,958 deals. I deduct deals whose target country is not the US. The filter results in 360,208 deals. Bloomberg M&A database classifies deals according to the industry of the target. Industry-level data on acquirers is not available for the majority of deals. Therefore, unlike Harford (2005), I use US targets, not US acquirers. I also exclude 2,565 deals that are terminated or withdrawn. I add the criteria that the acquirer owns less than 50% of shares prior to the transaction and more than 50% following the transaction. This step eliminates acquisitions of minority interest. The resulting sample covers 104,464 deals.

Table 5 Sample Filters

Bloomberg Filters	N	%
Initial sample: All M&A announcements between April 2012 – March 2022	471,958	100.0%
Less: Observations with target domicile outside of the US	360,208	76.3%
Less: Observations with the status Withdrawn and Terminated	2,565	0.5%
Less: Observations with acquisitions of minority interest or no control	4,721	1.0%
Final sample	104,464	22.1%

In my sample, 38,131 acquirers and 2,987 targets are public firms. There are 20,017 deals with announced deal values over $1 million. Netter et al. (2011) state that when deals with undisclosed deal values are included, sample size increases and merger waves become insignificant. The authors state clustering of mergers is due to public acquirers. Therefore, sampling choice is critical in the identification of merger waves.

If I use Harford (2005) filter to include deals with a value of more than $50 million, the sample size decreases to 14,954 or by 86 percent of the full sample. I use a more comprehensive sample with disclosed and undisclosed deal values and public and private targets and acquirers to avoid the sampling bias (Netter et al., 2011).

CHAPTER IV: METHODOLOGY

I adapt the methodology Harford (2005) developed to identify industry-level merger waves. Harford (2005) found the two years with the maximum number of deals in each industry within a decade and identified it as a potential wave. There were 50 potential waves in a decade, corresponding to a merger wave in every 50 industries. In order to test if the potential wave for an industry is a merger wave, the author took a deal from a decade and assigned it to a random month within that decade. He did the same for all deals. All deals in a decade were randomly assigned to months within that decade while keeping the total number of bids unchanged. After the random assignment of all deals, he found the maximum number of deals in two years within a decade. He then calculated the concentration ratio defined as maximum number of deals in an industry in a consecutive 24-month period divided by the total number of deals in that industry over the entire sample period of 10 years. The author repeated this simulation 1000 times. The 1000 simulations yielded the distribution of concentration ratios in each industry. The method identifies an industry M&A wave if the concentration ratio of the potential wave using realized M&A deal data in the industry exceeded the 95th percentile of the simulated distribution of concentration ratios.

Harford (2005) counts a deal twice, one for the target industry and one for the bidder industry if the bidder and target are from different industries. Unlike the author, I only consider the target industry and count each deal once. Due to data availability, I don't use the bidder's industry in my analysis. For most deals, the classification of bidder's industry is not available on Bloomberg.

CHAPTER V: RESULTS

Bloomberg Industry Classification System categorizes industries into 73 groups. I further grouped industries according to similarity in business lines.

(i) I grouped the two industries, Apparel and Textiles, into one industry;

(ii) I grouped the six industries, Investment Companies, Closed-end Funds, Closed-end Country Funds, Diversified Financial Services, Private Equity, Savings and Loans, into one industry;

(iii) I grouped the two industries, Auto Manufacturers and Auto Parts & Equipment, into one industry;

(iv) I grouped the two industries, Biotechnology and Pharmaceuticals, into one industry;

(v) I grouped the three industries, Entertainment, Food Service and Lodging, into one industry;

(vi) I grouped the two industries, Agriculture and Food, into one industry; I grouped the three industries Home Furnishings, Office Furnishings, and Office/Business Equip into one industry; I grouped the three industries Household Products, Housewares and Cosmetics/Personal Care into one industry;

(vii) I grouped the two industries, Computers and Electronics, into one industry;

(viii) I grouped the three industries, Airlines, Transportation, Trucking & Leasing, into one industry;

(ix) I grouped the three industries, Machiner-Constr&Mining, Machinery-Diversified, and Hand/Machine Tools, into one industry;

(x) I grouped the two industries, Storage/Warehousing, Environmental Control, into one industry;

(xi) I grouped the three industries, Gas, Oil & Gas, and Pipelines, into one industry.

This grouping resulted in 50 industries. The sample covers the number of M&A deals for every 50 industries across the 120 sample months from April 1, 2012, to March 31, 2022.

Table 5 lists the industries and the number of deals in each industry from April 1, 2012, to March 31, 2022. Each year in the Table starts on April 1 of the previous year and ends on March 31 of the table year. There were 419 deals in Real Estate industry from April 1, 2012 to March 31, 2013.

Table 6 Number of Merger Deals by Industry

Industry	Q2 2012 Q1 2013	Q2 2013 Q1 2014	Q2 2014 Q1 2015	Q2 2015 Q1 2016	Q2 2016 Q1 2017	Q2 2017 Q1 2018	Q2 2018 Q1 2019	Q2 2019 Q1 2020	Q2 2020 Q1 2021	Q2 2021 Q1 2022
Real Estate	419	784	1268	1367	1615	1827	1990	1317	294	461
REITS	128	239	180	152	387	623	641	1669	2170	4203
Commercial Services	744	835	920	938	831	827	970	956	919	1321
Software	573	611	736	838	829	894	914	887	1049	1624
Finance	256	251	338	387	417	425	518	713	603	894
Computers, Electronics	295	267	304	366	388	420	470	471	521	732
Healthcare-Services	288	276	326	379	418	389	431	418	454	731
Internet	453	431	449	436	347	329	354	373	313	478
Retail	198	229	257	298	286	313	348	350	305	460
Biotechnology & Pharmaceuticals	193	228	237	287	279	277	344	330	374	365
Insurance	195	151	191	273	231	250	284	301	397	480
Gas, Oil & Gas, Pipelines	293	279	297	211	258	227	194	190	170	245
Agriculture & Food	185	181	206	203	236	231	252	252	231	320
Healthcare-Products	184	160	178	232	195	197	221	221	234	312
Entertainment, Food service & Lodging	174	159	212	257	232	239	230	197	146	215
Engineering&Construction	121	130	153	217	168	211	242	231	214	338
Machiner-Constr&Mining, Machinery-Diversified, Hand/Machine Tools	149	127	150	184	189	173	224	215	215	332
Advertising	100	101	161	153	205	201	188	178	192	283
Banks	173	217	200	226	163	167	173	161	76	138
Telecommunications	156	152	128	147	163	153	123	138	165	178
Building Materials	97	98	121	132	172	126	169	123	138	303
Airlines, Transportation, Trucking & Leasing	119	110	90	137	123	150	177	160	121	210
Energy-Alternate Sources	72	92	111	126	148	106	144	140	167	243
Miscellaneous Manufacturing	182	170	155	141	123	125	131	83	75	124
Media	165	151	156	138	118	132	139	94	78	104
Storage, Warehousing, Environmental Control	105	107	103	106	101	97	136	124	153	174
Chemicals	103	113	116	132	131	110	108	116	89	153
Home Builders	435	204	37	156	83	34	33	40	28	46
Auto Manufacturers, Auto Parts & Equipment	58	83	94	108	101	85	104	108	120	170

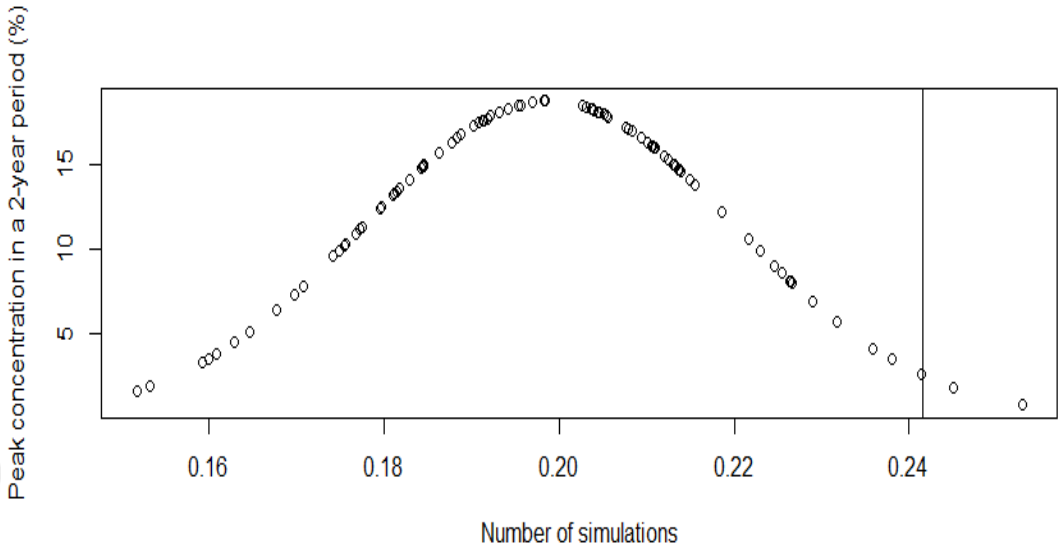
Industry	Q2 2012 Q1 2013	Q2 2013 Q1 2014	Q2 2014 Q1 2015	Q2 2015 Q1 2016	Q2 2016 Q1 2017	Q2 2017 Q1 2018	Q2 2018 Q1 2019	Q2 2019 Q1 2020	Q2 2020 Q1 2021	Q2 2021 Q1 2022
Mining	89	74	52	73	108	60	97	104	152	181
Distribution/Wholesale	53	71	71	74	93	70	93	104	92	163
Leisure Time	68	60	86	88	84	100	104	84	81	123
Household Products/Wares, Housewares, Cosmetics/Personal Care	55	49	53	76	84	92	84	74	93	174
Oil&Gas Services	60	86	95	73	142	82	92	75	52	54
Metal Fabricate/Hardware	48	57	67	82	83	65	80	102	71	93
Apparel & Textiles	50	51	60	74	74	70	76	63	40	76
Home Furnishings, Office Furnishings, Office/Business Equip	28	38	42	59	53	54	83	67	62	89
Beverages	46	44	58	84	65	54	56	46	54	65
Electrical Compo&Equip	62	69	40	72	71	48	44	51	42	50
Packaging&Containers	26	28	44	44	49	65	70	45	46	98
Aerospace/Defense	38	42	52	49	40	35	51	59	53	86
Electric	34	44	41	40	39	39	41	46	42	45
Semiconductors	34	42	52	45	45	22	32	37	35	44
Forest Products&Paper	16	27	39	27	31	31	20	17	26	45
Water	22	23	29	29	15	26	34	30	25	37
Iron/Steel	24	15	25	16	21	14	17	19	23	27
Holding Companies-Divers	42	21	42	18	16	11	11	6	9	7
Coal	7	20	9	15	9	8	11	13	3	4
Toys/Games/Hobbies	7	7	8	7	7	8	16	14	5	7
Shipbuilding	-	8	5	9	7	4	13	6	4	17

Source: Bloomberg

I randomly assign each merger deal in an industry to one of the 120 months. I calculate the maximum number of deals within two years. I repeat this 1000 times. I then use Harford (2005) to calculate the concentration ratio, defined as the maximum number of deals in an industry in a consecutive 24-month period divided by the total number of deals in that industry over the entire sample period of 10 years. This results in 1000 concentration ratios for an industry. Using the simulated distribution, I find the 95th percentile of concentration ratios in each industry. If the realized highest 24-month concentration ratio of deals in an industry exceeds the 95th percentile, I identify the potential wave period as a merger wave.

I illustrate how I identify merger waves in the Software industry. There are 8,955 merger deals in the Software industry from April 1, 2012, to March 31, 2022. The maximum number of deals in a 24-month period is 2,673; divided by the total number of deals in the 10-year period of 8,955, gives the concentration ratio of 29.9% in the potential wave period. In other words, 29.9% of deals in the Software industry from April 2012 to March 2022 concentrated in the 24-month period from April 2020 to March 2022. Figure 5 shows the distribution of the maximum concentration ratios in the 1000 simulations in the Software industry. The vertical line in Figure 5 shows the 95th percentile in the 1000 simulations. The realized deal concentration of 29.9% is larger than 24.2 %, corresponding to the 95th percentile of the simulated concentration ratios. As such, I identify the period from April 2020 to March 2022 as a merger wave in the software industry.

Figure 5 Distribution of Peak Deal Concentration in a 2-year period in the 1000 Simulations for the Software Industry



Appendix B shows the maximum realized concentration ratios and 95th percentile concentration ratios in the 1000 simulations for all industries.

5.1 Industry Level Merger Waves

I identify a merger wave in 37 of the 50 industries in the sample. 23 of the merger waves coincide with the Covid-19 pandemic period. Table 6 reports the industry-level waves and the month the wave started.

Table 7 Industries with Merger Waves

Industry	Merger Wave Started in	Industry	Merger Wave Started in
Software	April 2020	Computers, Electronics	April 2020
REITS	April 2020	Construction & Mining Machinery, Diversified Machinery, Hand/Machine Tools	April 2020
Commercial Services	April 2020	Distribution/Wholesale	March 2020
Healthcare-Products	April 2020	Energy-Alternate Sources	April 2020
Healthcare-Services	April 2020	Packaging&Containers	April 2020
Finance	April 2020	Advertising	April 2020
Insurance	April 2020	Engineering&Construction	April 2020
Auto Manufacturers, Auto Parts & Equipment	April 2020	Building Materials	April 2020
Household Products/Wares, Housewares, Cosmetics/Personal Care	April 2020	Biotechnology & Pharmaceuticals	March 2020
Mining	March 2020	Shipbuilding	March 2020
Agriculture & Food	February 2020	Storage/Warehousing, Environmental Control	January 2020
Aerospace/Defense	January 2020	Home Furnishings, Office Furnishings, Office/Business Equip	June 2018
Toys/Games/Hobbies	November 2017	Airlines, Transportation, Trucking & Leasing	August 2017
Real Estate	July 2017	Oil&Gas Services	March 2016
Beverages	September 2014	Banks	April 2014
Semiconductors	February 2014	Holding Companies-Diversified	October 2013

Industry	Merger Wave Started in	Industry	Merger Wave Started in
Coal	March 2013	Gas, Oil & Gas, Pipelines	November 2012
Miscellaneous Manufacturing	August 2012	Media	June 2012
Home Builders	April 2012		

Industries that didn't have a merger wave between April 1, 2012, to March 31, 2022, are Apparel & Textiles, Chemicals, Electric, Electrical Components & Equipments, Entertainment & Food Service & Lodging, Forest Products & Paper, Internet, Iron/Steel, Metal Fabricate/Hardware, Miscellaneous Manufacturing, Retail, Telecommunications and Water. Apparel & Textiles, Chemicals, Forest Products & Paper, Iron/Steel and Metal Fabricate/Hardware industries are the most energy-dependent industries in US and consume 56% of the total energy consumed in the manufacturing industry of US (US Energy Information Administration, 2018).

I plot the 95th percentile concentration ratios from the 1000 simulations and the realized concentration ratios of industry-level waves in Figure 6 and Figure 7. Figure 6 shows the merger waves during the pandemic and Figure 7 shows the industry-level waves that occur before the pandemic. In Figure 6, a wide gap between the 95th percentile and actual concentration in an industry such as REITS means that most deals in the analysis period concentrated in the Covid-19 pandemic period.

Figure 6 Covid-19 Industry Level Merger Waves 95th percentile Concentration Ratio and Actual Peak Concentration (%)

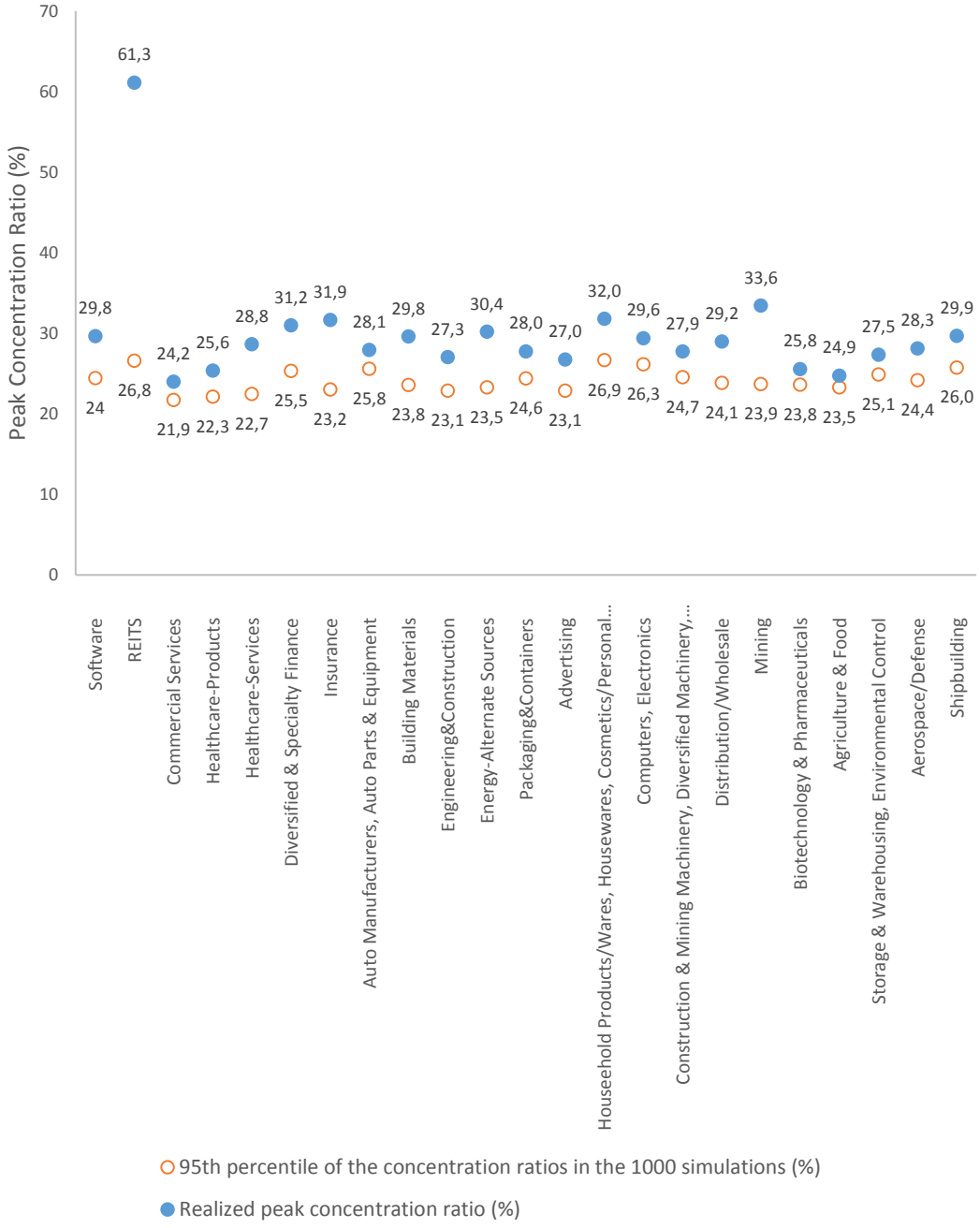
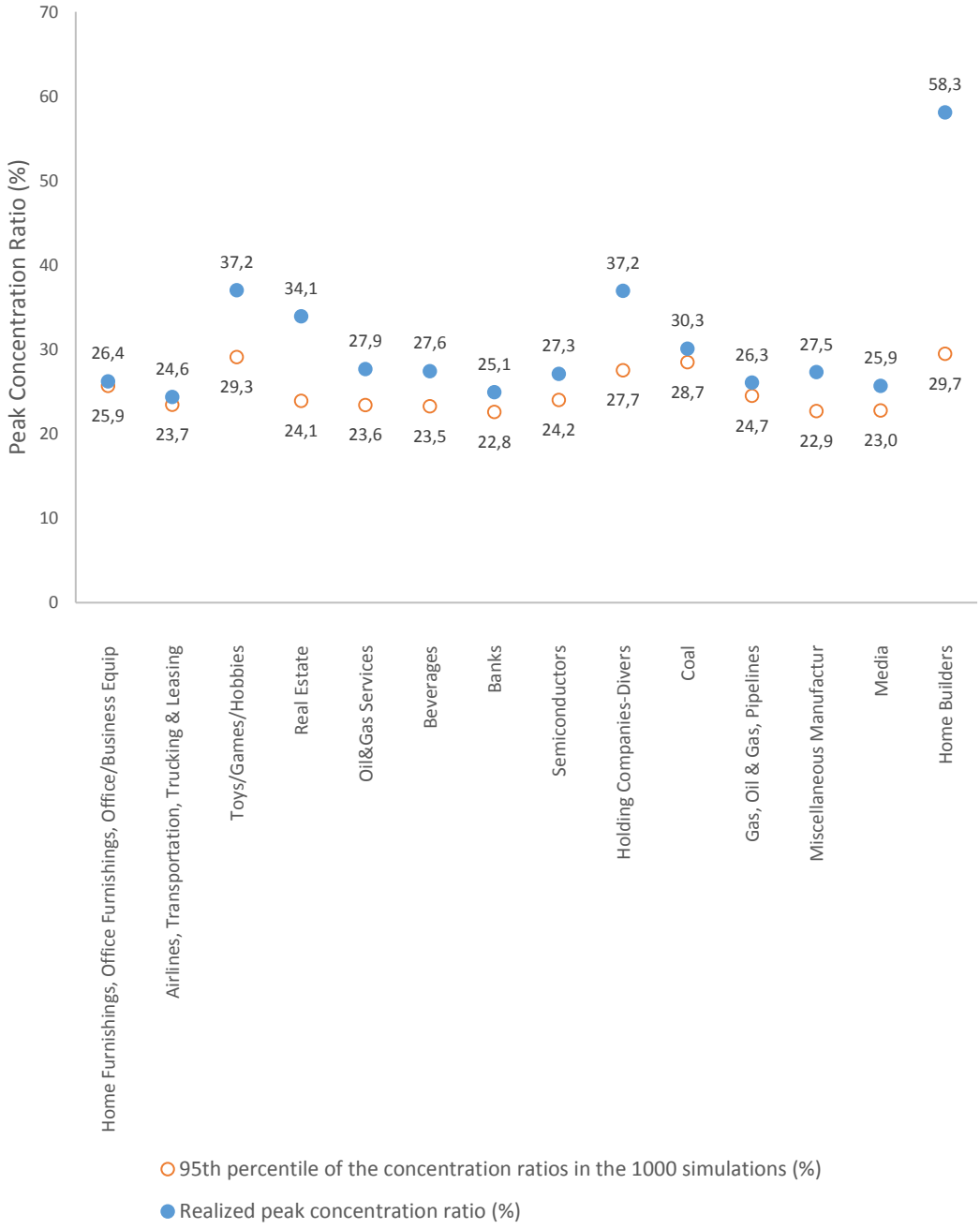


Figure 7 Merger Waves between April 1, 2012 to December 31, 2019 95th percentile Concentration Ratio vs Actual Peak Concentration (%)

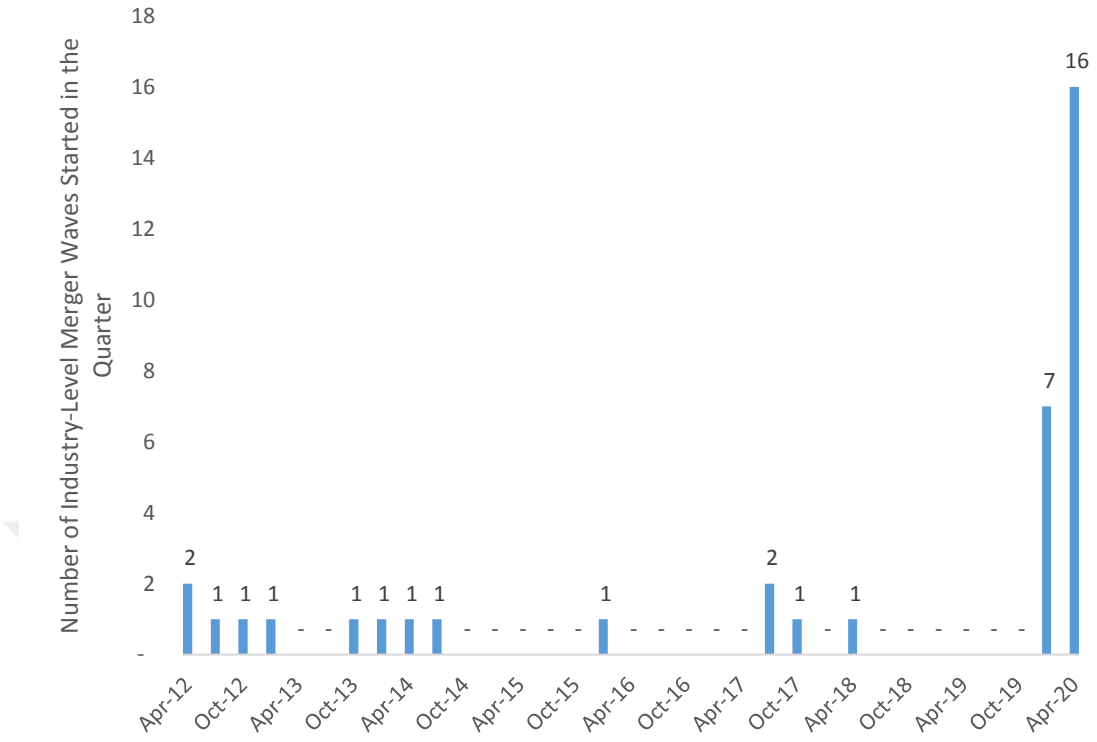


5.2 Industry Level Merger Waves to Aggregate Merger Wave

Using Harford (2005) method to identify merger waves at the aggregate level, I find the maximum number of total deals in a 24-month period divided by the total number of deals from April 1, 2012, to March 31, 2022. The realized peak concentration ratio at the aggregate level for the potential wave is 26.7%. I randomly assigned the 104,464 deals representing the whole sample to 120 months 1000 times. The 95% percentile in the distribution of maximum concentration ratio in a 2-year period for the simulated sample is 25.2%. Since the realized concentration ratio is more than the 95% percentile in the distribution, I identify it as an aggregate wave. The aggregate merger wave starts in April 2020 and ends in March 2022.

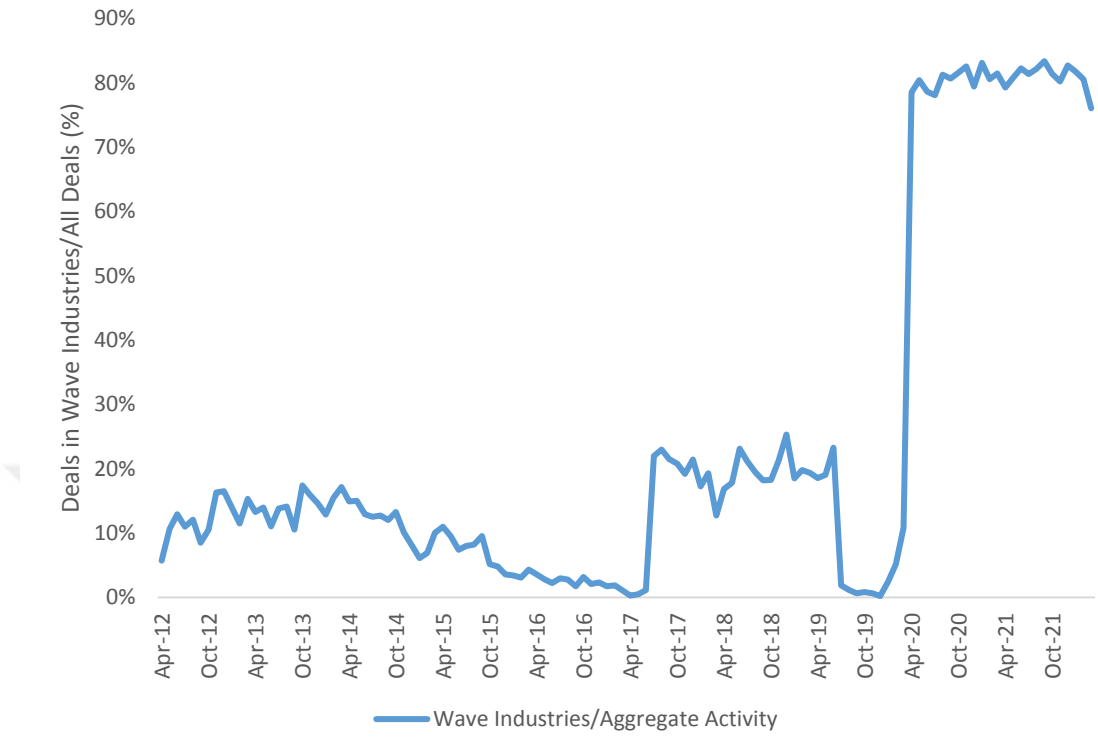
Harford (2005) states that most deals in an aggregate merger wave are due to the clustering of industry-level merger waves. To formally test whether industry-level merger waves drive aggregate merger waves, the author calculates the ratio of the number of deals in industries going through waves to the total number of deals in that quarter. Then he correlates this ratio with the total number of deals. Figure 8 shows that the number of industry-level merger waves increases significantly during the Covid-19 pandemic period.

Figure 8 Number of Industry Merger Waves and the Wave Start Quarter



During the Covid-19 pandemic period, the ratio of merger bids in industries going through an industry-level merger wave to all announced merger deals was 80%, while it averaged 11.2% in the pre-pandemic period per month. Figure 9 shows the trend of merger wave deals in all deals per month.

Figure 9 Monthly Ratio of Deals in Wave Industries to All Deals



I calculate the same ratio as Harford (2005) as another formal test of the relation between industry-level and aggregate merger waves. I regress the total number of deals of industry-level merger waves to a total number of deals of all industries by quarter, where the total number of deals is the dependent variable. Adjusted R^2 of 62% suggests that the variation in industry-level deals explains 62% of the total number of deals. I identify that while the ratio of merger wave deals to all deals increases, an aggregate merger wave started in April 2020. This is in line with the literature and my hypothesis that the aggregate merger wave starting in April 2020 is due to the clustering of industry-level merger waves.

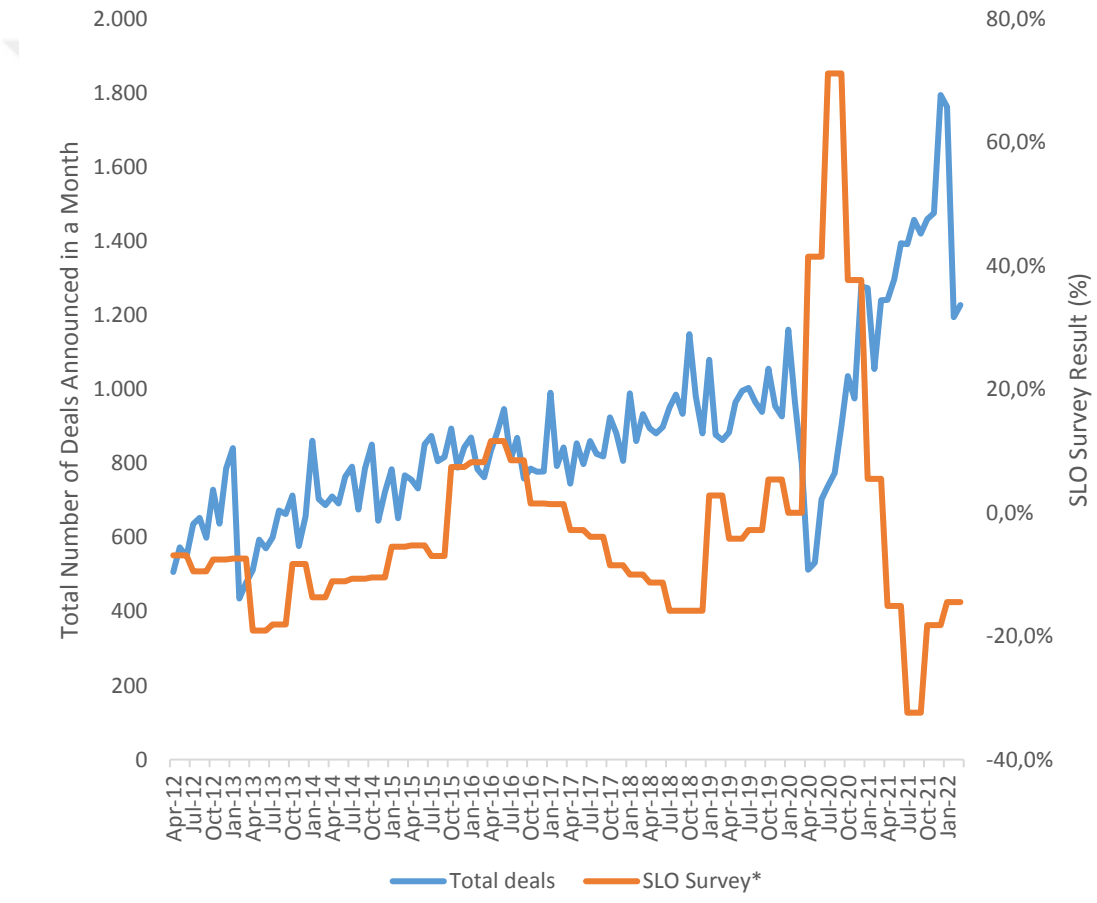
Table 8 Regression Results for Industry Level and Aggregate Level Deals

Regression Statistics	
R Square	0.620
Adjusted R Square	0.617
Standard Error	153.673
Observations	120

5.3 Capital Liquidity and Merger Waves

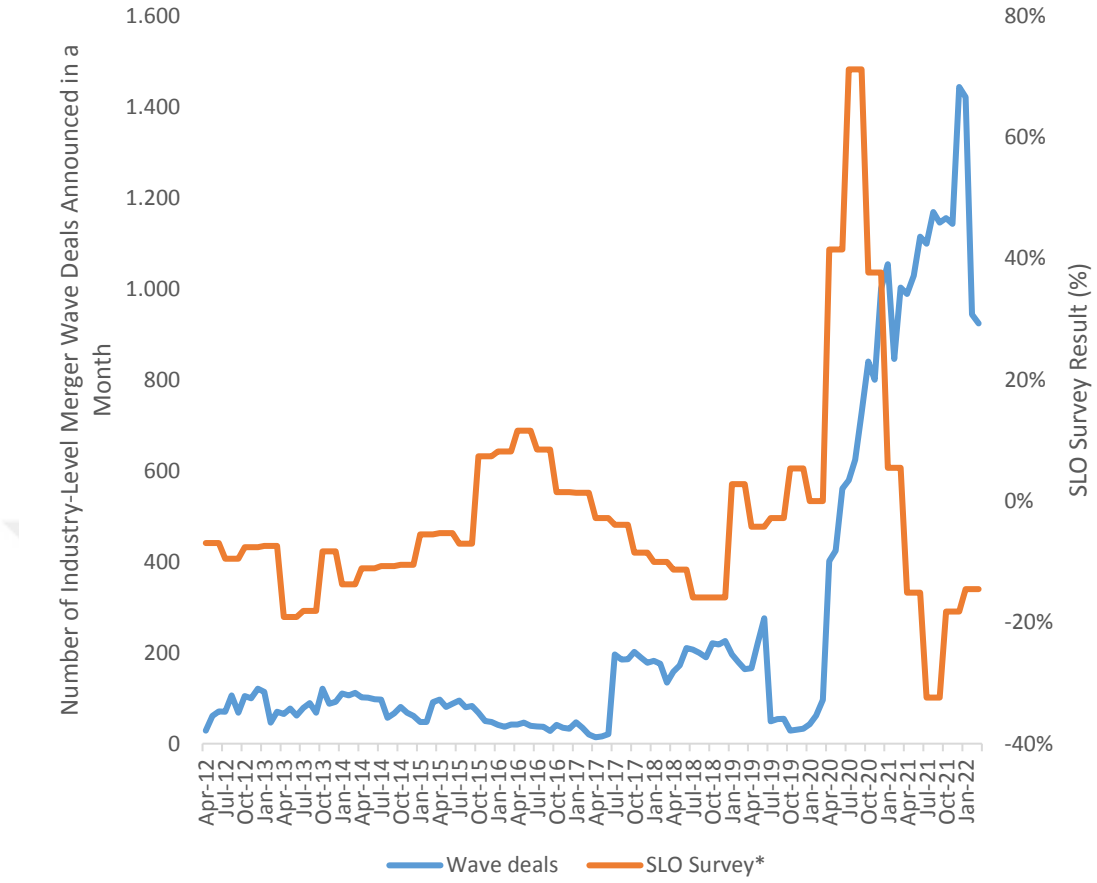
Harford (2005) states industry-level merger waves as a reaction to industry-shocks cluster only when there is sufficient capital liquidity. Figure 10 and 11 show the inverse relationship between capital liquidity proxied by SLO Survey results and total deal count. A negative trend in SLO Survey means capital liquidity becomes more available

Figure 10 Monthly Aggregate Number of Deals and Liquidity



*Moving average of Net Percentage of Domestic Respondents Tightening Standards for Commercial and Industrial Loans for Large and Medium Institutions

Figure 11 Monthly Industry Level Merger Waves and Liquidity



*Moving average of Net Percentage of Domestic Respondents Tightening Standards for Commercial and Industrial Loans for Large and Medium Institutions

A difference between Figure 10 and Figure 11 is that after the first announcement of the pandemic in March 2020, while the number of deals of industry level waves increase, total number of deals decrease signaling a difference in wave industries' and other industries' access to/availability of capital. The correlation between SLO Survey results and aggregate number of deals is 2% for April 1, 2012 to March 31, 2022. However, during the Covid-19 pandemic period between January 1, 2020 to March 31, 2022, this correlation is -46% signaling that in the Covid-19 pandemic period, availability of capital liquidity explained more of the variation in number of deals.

5.4 Societal Impact

Merger waves are periods of "large, discrete, unsustainable increase" in merger activity (Town, 1992). Industry-shocks trigger merger waves that result in “large scale reallocation of assets” (Harford, 2005). The result of the first five merger waves were significant changes to industry structure resulting in monopolies, oligopolies and structures with less market power of major players. Increased market power and scale economies translate to higher profitability for firms. In addition, considering the intensity of cross-border transactions in the fifth merger wave, globalization is another impact of merger wave.

As I focus on industry-level merger waves, the results of my study point to industries that will go through significant structural changes. Considering that merger activity transmits to close industries quickly and distant industries with a delay (Ahern and Harford, 2012) the economy as a whole will be affected as a result of the 6th merger wave I identified.

Regarding the societal impact of changes in industry and firm structures, Kleinert and Klodt (2002) investigated the impact of the fifth merger wave in 1990s on profitability and employment. The authors state buyer’s profitability decreases and total employment by bidder and target firms also decreased following the fifth merger wave. Blonigen and Pierce (2016) state profitability increases following M&As and there is no significant improvement in productivity and efficiency. Increases in profitability and lower employment result in higher prices for consumers and deteroriating economic welfare (Blonigen and Pierce, 2016).

I expect changes in profitability, efficiency/productivity and employment of the industries going through the 6th merger wave. Due to industry links as Ahern and Harford (2012) stated, the economy as a whole will be affected from the Covid-19 pandemic merger wave.

CHAPTER VI: CONCLUSION

This thesis investigates whether Covid-19 pandemic period coincided with an aggregate merger wave driven by industry-level merger waves. During the Covid-19 pandemic period, there was a significant increase in US stock market indices, volatility in energy prices, GDP growth, employment rate increase, and accelerated digitalization. Since determinants of merger waves such as industry shocks, economic expansion and stock market boom coincide with the recovery from the Covid-19 pandemic starting in April, 2020, I expect an aggregate merger wave. My study provides evidence that an aggregate merger wave started in April 2020 and industry-level merger waves drive it. The sample I use covers April 1, 2012, to March 31, 2022. Merger data is from Bloomberg for merger deals of public and private US targets. Industry classification is according to Bloomberg Industry Classification System in Bloomberg Terminal Equities Tab.

First, I test 50 industries between April 1, 2012, to March 31, 2022, to identify industry-level merger waves. 62% of the variation in total number of deals is explained by the variation in the number of deals in industry-level merger waves. This is in line with Mitchell & Mulherin's (1996) and Harford's (2005) hypothesis that industry-level merger waves drive aggregate merger waves. Results show 37 industry-level merger waves between April 1, 2012, to March 31, 2022. 23 of these industry-level waves started during the Covid-19 pandemic period between January 1, 2020, to March 31, 2022. Those industries that had industry-level merger waves from January 1, 2020, to March 31, 2022, are Software, Real Estate Investment Trusts (REITs), Commercial Services, Healthcare Products, Healthcare Services, Finance, Insurance, Auto Manufacturers & Auto Parts, Building Materials, Engineering & Construction, Renewable Energy, Packaging & Containers, Advertising, Household Products/Wares, Computers & Electronics, Machinery, Distribution/Wholesale, Mining, Biotechnology & Pharmaceuticals, Agriculture & Food, Storage & Warehousing & Environmental Control, Aerospace & Defense and Shipbuilding.

Second, regarding Harford's (2005) hypothesis that industry-level merger waves cluster in the existence of industry-shocks but only when capital liquidity is available, I found that there is an inverse trend and a correlation of -46% between tightening standards of capital liquidity and industry-level and aggregate number of deals during Covid-19 pandemic period.

To sum up, my results show that the Covid-19 pandemic period coincides with an aggregate merger wave comprised of industry-level merger waves.

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Appendix A – Bloomberg Industry Classification System

Level 1 Sector	Level 2 Industry Group	Level 3 Industry	Level 4 Sub Industry
Communications	Media	Advertising & Marketing	Advertising & Marketing
		Cable & Satellite	Cable & Satellite
		Entertainment Content	Film & TV
			Music
			Video Games
		Publishing & Broadcasting	Publishing
			Local TV & Radio Broadcast
			Out-of-Home Display Advertising
		Internet Media & Services	Internet Media & Services
	Telecommunications	Telecommunications	Wireless Telecommunications
			Wireline Telecommunications
Consumer Discretionary	Consumer Discretionary Products	Apparel & Textile Products	Apparel, Footwear & Acc Design
			Textile & Textile Products
		Automotive	Automobiles
			Auto Parts
		Home Construction	Homebuilding
			Building Products
		Home & Office Products	Household Appliances
			Furniture
			Housewares
			Office Supplies
		Leisure Products	Toys & Games
			Music Instruments
			Recreational Vehicles
			Sporting Goods
	Consumer Discretionary Services	Consumer Services	Consumer Goods Rental
			Educational Services
			Funeral Services
			Non-Profit Organization
			Personal Care Services
			Photography Services

Level 1 Sector	Level 2 Industry Group	Level 3 Industry	Level 4 Sub Industry
			Political Committees
			Residential Contractors
			Other Consumer Services
		Leisure Facilities & Services	Casinos & Gaming
			Cruise Lines
			Lodging
			Restaurants
			Entertainment Facilities
			Travel Services
	Retail & While - Discretionary	Wholesale - Discretionary	Apparel & Footwear Whslrs
			Automotive Wholesalers
			Consumer Elec & Applc Whslrs
			Home & Office Product Whslrs
			Other Wholesalers
			Import & Export
		Retail - Discretionary	Automotive Retailers
			Catalog & TV Based Retailers
			Electronics & Appliances Stores
			Department Stores
			Home Products Stores
			Jewelry & Watch Stores
			Specialty Apparel Stores
			Sporting Goods Stores
			Other Spec Retail - Discr
		E-Commerce Discretionary	Online Marketplace
			Specialty Online Retailers
Consumer Staples	Consumer Staple Products	Food	Agricultural Producers
			Packaged Food
		Beverages	Alcoholic Beverages
			Non-Alcoholic Beverages
		Tobacco & Cannabis	Tobacco
			Cannabis
		Household Products	Home Products
			Personal Care Products

Level 1 Sector	Level 2 Industry Group	Level 3 Industry	Level 4 Sub Industry
	Retail & Wholesale - Staples	Wholesale - Consumer Staples	Agricultural Products Whslrs
			Food & Beverage Wholesalers
			Other Wholesalers - Staples
		Retail - Consumer Staples	Food & Drug Stores
			Mass Merchants
Energy	Oil & Gas	Oil & Gas Producers	Integrated Oils
			Exploration & Production
			Midstream - Oil & Gas
			Refining & Marketing
		Oil & Gas Services & Equip	Drilling & Drilling Support
			Oilfield Services & Equipment
	Renewable Energy	Renewable Energy	Biofuels
			Renewable Energy Equipment
			Renewable Energy Project Dev
Financials	Banking	Banking	Diversified Banks
			Banks
	Financial Services	Asset Management	Investment Companies
			Investment Management
			Private Equity
			Wealth Management
		Specialty Finance	Commercial Finance
			Consumer Finance
			Mortgage Finance
			Other Financial Services
		Institutional Financial Svcs	Institutional Brokerage
			Install Trust, Fiduciary & Custody
			Security & Cmdty Exchanges
	Insurance	Insurance	Life Insurance
			P&C Insurance
			Islamic Insurance
			Reinsurance
			Insurance Brokers & Services

Level 1 Sector	Level 2 Industry Group	Level 3 Industry	Level 4 Sub Industry
Real Estate	Real Estate	Real Estate Owners & Developers	Multi-Asset Class Own & Develop
			Health Care Owners & Develop
			Hotel Owners & Developers
			Residential Owners & Developers
			Industrial Owners & Developers
			Office Owners & Developers
			Retail Owners & Developers
			Self-Storage Owners & Develop
			Specialty Owners & Developers
		REIT	Multi Asset Class REIT
			Health Care REIT
			Hotel REIT
			Residential REIT
			Industrial REIT
			Office REIT
			Retail REIT
			Self-storage REIT
			Timber REIT
			Data Center REIT
			Infrastructure REIT
			Gaming REIT
			Specialty REIT
		Real Estate Services	Real Estate Services
Health Care	Health Care	Biotech & Pharma	Large Pharma
			Biotech
			Specialty & Generic Pharma
		Health Care Facilities & Svcs	Health Care Facilities
			Health Care Services
			Health Care Supply Chain

Level 1 Sector	Level 2 Industry Group	Level 3 Industry	Level 4 Sub Industry
			Managed Care
		Medical Equipment & Devices	Health Care Supplies
			Life Science & Diagnostics
			Medical Devices
			Medical Equipment
Industrials	Industrial Products	Diversified Industrials	Diversified Industrials
		Aerospace & Defense	Aircraft & Parts
			Defence
		Electrical Equipment	Comml & Res Bldg Equip & Sys
			Electrical Power Equipment
			Industrial Automation Controls
			Measurement Instruments
			Electrical Components
		Machinery	Agricultural Machinery
			Construction & Mining Machinery
			Engine & Transmission
			Factory Automation Equipment
			Flow Control Equipment
			Other Machinery & Equipment
			Material Handling Machinery
			Metalworking Machinery
			Pollution Control Equipment
		Transportation Equipment	Commercial Vehicles
			Railroad Rolling Stock
			Shipbuilding
		Industrial Intermediate Prod	Fabricated Metal & Hardware
			Rubber & Plastic
	Industrial Services	Industrial Support Services	Industrial Wholesale & Rental
			Industrial Maintenance Svcs
		Commercial Support Services	Building Maintenance Services

Level 1 Sector	Level 2 Industry Group	Level 3 Industry	Level 4 Sub Industry
			Food Services
			Printing Services
			Security Services
			Other Commercial Support Svcs
			Waste Management
			Professional Services
		Transportation & Logistics	Airlines
			Air Freight
			Courier Services
			Marine Shipping
			Rail Freight
			Trucking
			Transit Services
			Logistics Services
			Transport Operations & Services
		Engineering & Construction	Engineering Services
			Infrastructure Construction
			Building Construction
Materials	Materials	Chemicals	Agricultural Chemicals
			Basic & Diversified Chemicals
			Specialty Chemicals
			Chemicals Distribution
		Construction Materials	Cement & Aggregates
			Building Materials
		Containers & Packaging	Containers & Packaging
		Forestry, Paper & Wood Products	Forestry & Logging
			Paper & Pulp Mills
			Wood Products
		Steel	Steel Producers
			Metal Svc Centers & Processors
		Metals & Mining	Iron

Level 1 Sector	Level 2 Industry Group	Level 3 Industry	Level 4 Sub Industry
			Base Metals
			Precious Metals
			Mineral & Precious Stone Mining
			Coal Mining
			Mining Services
			Metals & Ore Whslrs & Traders
Technology	Tech Hardware & Semiconductors	Technology Hardware	Communications Equipment
			Consumer Electronics
			Computer Hardware & Storage
			Specialty Technology Hardware
			Electronic Components
			EMS/ODM
			Technology Distributors
		Semiconductors	Semiconductor Mfg
			Semiconductor Devices
	Software & Tech Services	Software	Application Software
			Infrastructure Software
		Technology Services	IT Services
			Information Services
			Data & Transaction Processors
Utilities	Utilities	Electric Utilities	Integrated Electric Utilities
			Power Generation
			Electric Transmission & Distribution
			District Heating & Cooling
		Gas & Water Utilities	Gas Utilities
			Water Utilities
		Elec & Gas Marketing & Trading	Elec & Gas Marketing & Trading

Appendix B – Merger wave period deal concentration and 95th percentile concentration by industry

Industry	Concentration in Wave Period (%)	95th percentile (%)
Software	29.85	24.16
REITS	61.33	26.80
Commercial Services	24.19	21.93
Healthcare-Products	25.59	22.34
Healthcare-Services	28.83	22.67
Finance	31.17	25.54
Insurance	31.86	23.21
Auto Manufacturers, Auto Parts & Equipment	28.13	25.81
Building Materials	29.82	23.79
Engineering&Construction	27.26	23.08
Energy-Alternate Sources	30.39	23.48
Packaging&Containers	27.96	24.59
Advertising	26.96	23.07
Household Products/Wares, Housewares, Cosmetics/Personal Care	32.01	26.87
Computers, Electronics	29.59	26.34
Construction & Mining Machinery, Diversified Machinery, Hand/Machine Tools	27.94	24.75
Distribution/Wholesale	29.19	24.06
Mining	33.64	23.90
Shipbuilding	29.89	25.96
Biotechnology & Pharmaceuticals	25.77	23.83
Agriculture & Food	24.95	23.50
Storage & Warehousing, Environmental Control	27.53	25.08
Aerospace/Defense	28.32	24.37
Home Furnishings, Office Furnishings, Office/Business Equip	26.43	25.88
Airlines, Transportation, Trucking & Leasing	24.55	23.66
Toys/Games/Hobbies	37.21	29.31
Real Estate	34.12	24.12
Oil&Gas Services	27.87	23.60
Beverages	27.62	23.48
Banks	25.15	22.78
Semiconductors	27.32	24.21

Industry	Concentration in Wave Period (%)	95th percentile (%)
Holding Companies-Divers	37.16	27.73
Coal	30.30	28.67
Gas, Oil & Gas, Pipelines	26.27	24.70
Miscellaneous Manufacturing	27.50	22.92
Media	25.88	22.96
Home Builders	58.30	29.70
Apparel & Textiles	24.13	26.81
Chemicals	22.97	24.98
Electric	25.10	26.92
Electrical Compo&Equip	26.01	28.77
Entertainment, Foodservice & Lodging	24.16	25.67
Forest Products&Paper	25.45	27.16
Internet	23.32	26.27
Iron/Steel	25.87	28.85
Leisure Time	23.35	25.91
Metal Fabricate/Hardware	24.33	26.31
Retail	25.13	26.90
Telecommunications	23.10	23.67
Water	25.18	26.46

Appendix C – Industry Level Revenue and Profitability Growth

BICS Industry	Revenue Growth (%)	Net income/Sales Growth (%)
All	-35.75	0.79
Real Estate	41.40	-11.74
Aerospace & Defense	40.81	-9.39
Building Materials	32.17	11.54
Energy-Alternate Sources	24.83	-12.55
Agriculture & Food	20.43	-5.98
Toys/Games/Hobbies	15.18	4.65
Engineering&Construction	2.63	6.75
Healthcare-Services	-5.84	3.11
Home Furnishings, Office Furnishings, Office/Business Equip	-11.80	20.71
Software	-13.36	12.88
Insurance	-14.86	13.37
Distribution/Wholesale	-18.10	12.28
Biotechnology & Pharmaceuticals	-18.75	10.16
Media	-21.67	-5.42
Apparel & Textiles	-22.09	13.47
Beverages	-26.37	-4.20
Healthcare-Products	-26.88	9.02
Home Builders	-28.86	1.10
Retail	-29.16	-8.80
Advertising	-31.17	3.23
Storage, Warehousing, Environmental Control	-35.13	2.32
Entertainment, Foodservice & Lodging	-36.86	-25.52
Finance	-46.57	-2.11
Household Products/Wares, Housewares, Cosmetics/Personal Care	-47.82	3.05
Computers, Electronics	-51.71	-22.19
Telecommunications	-57.22	-13.32
Machiner-Constr&Mining, Machinery-Diversified, Hand/Machine Tools	-59.06	2.19
REITS	-60.87	3.83
Electrical Compo&Equip	-70.02	-3.43
Semiconductors	-83.90	-3.38
Chemicals	-84.40	1.39
Oil&Gas Services	-84.83	-61.10
Miscellaneous Manufacturing	-87.70	-21.43
Packaging&Containers	-89.49	-4.96
Airlines, Transportation, Trucking & Leasing	-90.50	-5.68
Auto Manufacturers, Auto Parts & Equipment	-96.14	-16.01
Gas, Oil & Gas, Pipelines	-101.19	-27.06
Electric	-102.30	6.70
Mining	-109.94	4.77
Forest Products&Paper	-111.72	22.90
Iron/Steel	-127.46	-57.77
Banks	n.a	1.22

Source: Bloomberg

Appendix D – Industry Level Stock Market Return and P/B

BICS Industry	Return (%)	P/B
All	-20.6	2.28
Healthcare-Products	-19.80	5.36
Software	-14.60	5.13
Household Products/Wares, Housewares, Cosmetics/Personal Care	-5.70	4.90
Beverages	-34.50	4.48
Toys/Games/Hobbies	-34.20	3.74
Biotechnology & Pharmaceuticals	-24.20	3.72
Chemicals	-31.00	3.56
Aerospace & Defense	-24.20	3.31
Retail	-22.33	3.30
Semiconductors	3.20	3.27
Real Estate	-25.70	3.22
Miscellaneous Manufacturing	-18.83	3.18
Electrical Compo&Equip	-18.40	3.09
Healthcare-Services	-12.80	3.02
Building Materials	-11.50	2.80
REITS	-23.50	2.51
Media	-28.90	2.49
Airlines, Transportation, Trucking & Leasing	-28.70	2.48
Forest Products&Paper	26.00	2.36
Electric	-5.00	2.35
Packaging&Containers	-16.60	2.31
Entertainment, Foodservice & Lodging	-48.10	2.27
Auto Manufacturers, Auto Parts & Equipment	-24.80	2.20
Computers, Electronics	-25.70	2.09
Distribution/Wholesale	-21.65	2.02
Machiner-Constr&Mining, Machinery-Diversified, Hand/Machine Tools	-31.10	1.96
Agriculture & Food	-8.60	1.93
Home Builders	-18.90	1.92
Apparel & Textiles	-46.50	1.72
Engineering&Construction	-16.30	1.72
Home Furnishings, Office Furnishings, Office/Business Equip	-37.70	1.64
Gas, Oil & Gas, Pipelines	-66.40	1.63
Mining	-38.50	1.59
Telecommunications	-22.40	1.52
Finance	-19.20	1.52
Advertising	-48.00	1.45
Banks	-24.90	1.26
Energy-Alternate Sources	-27.80	1.20
Oil&Gas Services	-68.90	1.20
Insurance	-15.20	1.19
Iron/Steel	-40.70	1.10

Source: Bloomberg