ACADEMIA International Journal for Social Sciences
Volume 4, Issue 3, 2025 ISSN-L (Online): 3006-6638

Market Concentration and Innovation Horizon: Evidence from the US Firms

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Received: 09-04-2025 **Revised:** 10-05-2025 **Accepted:** 15-06-2025 **Published:** 01-07-2025

ABSTRACT

This paper investigates the correlation between market concentration, measuring the intensity of competition in an industry, with various innovation strategies used by companies such as short-term and long-term. A dataset comprising an unbalanced panel of U.S based firms was used in this study. To develop robust and valid conclusions, the analysis contains a combination of statistical and econometric tools such as regression analysis, multicollinearity diagnostics, endogeneity tests, as well as comprehensive robustness checks. These tools are employed to examine the dependence between innovation horizon, defined as time taken between investments in research & development activities and the eventual realization of innovation in form patent applications, and market concentration which is quantified as Herfindahl-Hirschman Index. Also, irrespective of model specifications selected for testing among various modelling scenarios, these robustness analyses substantiate the reasonableness of research findings and thus empirically proves significant linkage of higher market concentration with smaller innovation horizon. The results suggest that companies operating in highly concentrated markets tend to give preference to short-run innovation policies, which is probably caused by the extremely competitive environment, characterized by limited number of entities competing aggressively to enhance or retain their market share, in which these organizations operate. These insights contribute and enhance the extent to which market structure determines the strategic timing of innovation among firms, hence, yielding important implications for both innovation policy and managerial decision-making.

Keywords: *Innovation Horizon, Firm Innovation, Herfindahl-Hirschman Index, Market Competition*

INTRODUCTION

Corporate and business have advanced and changed significantly. The numerous industrial revolutions and the emergence and fall of corporations demonstrate that businesses who maintained their competitiveness and changed their product lines to adapt to the shifting conditions survive, while those that did not ultimately failed. Schumpeter, 1934 emphasized that the success of a business as well as economic progress depend heavily on innovation. He discussed in detail the impact of lack of innovation and how the entities who fail to do so eventually face obsolescence including failure. He termed this process as "creative destruction" with new, innovative firms replaced the outdated ones to better meet the evolving business / market needs. Companies that control the modern business world keep making significant investments in their goods and services and are engaged in a never-ending struggle to set

themselves apart from their rivals. To maintain their respective shares organizations, depending on their competitive pressure, use varied innovation approaches with some prioritizing long-term profitability, some employing mixed practices in accordance with their product portfolio and remaining focusing on gaining short-term profitability to hold their ground and prevail in the market (Kamber & Rizzo, 2020; Aghion et al., 2005). Innovation is a major economic-development-driver that triggers technological growth, strengthens the capabilities of firms, and facilitates the achievement of sustainability. Accordingly, companies are confronted with complicated decisions on timing and scale of their innovative projects between short-term job performance and an opportunity to seek long-term competitive edge. Therefore, timing of innovation is extremely important for an entity to survive, stay relevant and grow their profitability.

Market concentration constitutes the extent to which only a couple of businesses control an industry or market where the exceedingly high percent of the industry / market's total sales, production, or assets are in their possession. It is a measure of how concentrated or competitive a market is. High market concentration indicates that a few large firms hold most of the market power, often leading to less competition, stronger barriers to entry for new firms, and likely greater control over prices and innovation. Conversely, low market concentration means more competition between the firms which eventually leads to innovation, better prices, and choice for consumers. To better understand industry dynamics, it is vital to know the level of market concentration. Previous studies have identified that market concentration influences a firms strategic behavior including investment in research & development Mairesse et al. (1995), Mansfield (1968), Cockburn et al. (1996) and Griliches et al. (1988), product pricing as well as long-term vs short-term (Kamber & Rizzo, 2020; Aghion et al., 2005) planning. The knowledge about market concentration is important for a firm in setting its marketing strategy. Theoretical and empirical literature indicates an inverse relationship between market-share concentration and efficiency, suggesting that the firms are more likely operate more efficiently in markets with lower concentration. Bain (1956) and Collins and Preston (1969) support not only the notion of this collusion but also the efficient-profitability hypothesis, i.e., larger firms in more concentrated markets are more profitable due to efficiencies associated with large-scale production i.e., economies of scale.

The degree of market share held by a small group of entities within a market and / or industry has major influence on strategic decision-making process. This research uses Herfindahl-Hirschman Index (HHI), originally developed by Herfindahl, as a metric to assess the relative size of firms within their competitive environment. The results obtained from Herfindahl-Hirschman Index offer valuable insights into the influence of leading companies and level of competition within an industry. Prior research has offered multiple insights into the competition levels in certain markets and their probability to influence a firm's desire to improve its offerings, but there is still contradiction in the outcome of those works. Some studies argued that a market with higher concentration is a favorable aspect for businesses as it empowers them with greater resources as well as stability, yet other works believe it to suppress innovative actions owing to lowered competition and thus a increasing probability of complacency. (Mairesse et al., 1995; Mansfield, 1968; Cockburn et al., 1996; Griliches et al., 1988; Audi et al., 2021; Oussama & Oluyede, 2022). The relationship between the concentration of the market and the time taken to innovate is an intricate question. Companies that are in concentrated markets prefer speed and immediacy in their innovation activities and as such prefer incremental improvement that can ensure their existence in the markets. On the other hand, organizations that are placed in less concentrated market areas are more likely to finance bigger and broader innovations, which help them to project future line of competition. (Wang & Ahmad, 2018; Margolis & Calderon, 2021; Audi et al., 2022).

This paper explores the relationship between industry concentration and time aspect of the corporate innovation activity. Specifically, this study explores whether organizations operating in highly concentrated markets tend to adopt short-term, accelerated innovation strategies in response to

competitive pressures and the immediate necessity to maintain market competitiveness. An analysis of existing literature reveals the fact that innovation strategies sometimes act as source of transition to future innovations. The proposition is however challenged in the economic literature. This disagreement is illustrated by the analysis of Levin et al. (1987) who accentuate the need to pay more attention to questioning the timing of the innovation itself to be able to predict the technological evolution future more effectively. Despite the recognition that there is a close relationship between the concentration of industries and innovativeness, not much has been empirically researched on the same relationship. The previous research, except some prominent exceptions, has been based on correlation designs not allowing enough control of confounding factors and industry-wide effects (Audi et al., 2018; Karhan, 2019; Fatima and Zaman, 2020; Glaeser and Yoo, 2024). To some degree, these studies highlight the impact of research and development processes on firm risk and explain that the innovation behavior is shaped by both internal organizational processes as well as its external contexts.

The proposed study aims at identifying the extent of interconnection between market concentration of a particular industry and the time orientation of novel-innovation activities of firms. In addressing this question, the fixed-effect regression models are complemented by instrumental variable methods to determine whether the organizations located in concentrated markets have a tendency of engaging in short-term innovation. It is expected that the findings will be seen by managers and other stakeholders in the industry who will subsequently be informed about the best time to innovate and how competition affects innovation change. Using the interplay between market concentration level and strategic innovation decisions and periods needed to instill the innovation processes, this study explains the management of such decisions in a wide range of competitive environments.

LITERATURE REVIEW

The connection between innovation and market / industry structure has been explored in the academic circles. This relationship has been noted to be influenced by highly complex relationship between the forces wielding of market power, level of competition, and strategic behaviors towards innovation. Schumpeterian economic theory argues that higher market concentration means the companies have more financial resources and in order to protect their profitability, they opt to forego these resources and in the long-term they spend more on research and innovative projects (Schumpeter, 1934). The structure-conduct-performance perspective laid out by (Bain, 1956) points out that high-ranking firms in monopolized markets may not be inclined toward investing in innovation activities as they may not be facing large number of competitors to deal with. These contrasting perspectives highlight the necessity of empirical investigation across different industries to validate their relevance. Mansfield (1968) noted that the less competitive industries spent proportionally more funds on research and development, and this feature positively linked market orientation to innovative potential. In such settings, he held that strong companies would have the ability of investing in continuous improvement programs to an extent that was manyfold. Griliches (1984) pursued this research question further by demonstrating that the composition of industries, especially firm density, affects levels of innovation. In highly concentrated industries, the innovation tends to occur slowly and gradually, and the rate of technological advance is also influenced by age of the market and regulatory environment. Even though large, dominant companies are likely to be linked with greater research and development expenditures, there is no guarantee that such companies will attain significant or sustained innovation breakthrough. Hashmi et al. (2010) studied the global auto market and determined prior surges in market concentration stimulated innovation as it allowed more research and development investments. However, beyond a certain threshold, concentration reduced competitive pressure and could diminish the intensity of innovation.

Mansfield (1968) found that the industries with less competitiveness spent relatively more on research and development thus creating a positive correlation between market focus and innovative ability. He

held that strong companies would have the ability of investing in continuous improvement programs to an extent that was manyfold. Griliches (1984), further demonstrated this direction of inquiry by demonstrating that industry structure, especially firm concentration, is a determinant of innovation activity. The outstanding industries usually show a smooth, step-by-step innovation and the rate of technological advancement is also influenced by the age of the market and the weak regulatory environment. Although the big, powerful companies are likely to relate to significant expenditures into research and development, such companies do not always attain significant or long-term innovation breakthroughs. Hashmi et al. (2010) studied the automobile industry and concluded that early surges in market concentration fostered the advancement because of allowing more spending in the field of research and development. However, beyond a certain threshold, concentration reduced competitive pressure and could diminish the intensity of innovation.

Mairesse et al. (1995) proved that companies operating in concentrated industries in France were indeed more likely to be involved in research and development practices and were more likely to hasten the process of designing and making new technical innovations as well as implementing them into the market. Cockburn et al. (1996) reported that expansion among biotechnology firms resulted in increased drug research spending and faster development cycles. Intense competition and regulatory challenges led firms to focus on shortening research times, often emphasizing minor improvements to existing pharmaceutical products. Griliches et al. (1988) observed that highly concentrated industries tend to introduce new products quickly, though such offerings may be less refined. Large pharmaceutical firms, for instance, produced more innovations but also shortened the time between development and market release, explaining that industry leaders prioritize both increased research expenditure and expedited innovation cycles. Mazzucato (2000) explored the evolution of firm size, market structure, and industry concentration, arguing that while dominant firms in concentrated markets possess substantial resources for innovation, they may also become complacent, potentially destabilizing the industry.

Brennan et al. (2000) provide a quantitative perspective on the biotechnology sector, explaining that while industry concentration can accelerate the innovation process, it may also dampen novelty if market power suppresses competitive intensity. Kamien and Schwartz (1975) provide a comprehensive overview of how market structure affects innovation, emphasizing that outcomes are often industry-specific and dependent on firm capabilities. Turner et al. (2010) analyze firm responsiveness in concentrated markets, showing that competitors tend to prefer incremental rather than radical innovation. Dolata (2017) investigates major digital firms such as Apple and Google, illustrating how leading companies utilize strategic innovation policies to maintain dominance. This demonstrates that high concentration can either impair or enhance innovative efforts, depending on both firm and industry strategy.

Cusumano et al. (2019) noted that the software industry exhibits both high concentration and rapid innovation cycles. Dominant firms tend to prioritize frequent incremental updates, especially in software products, to maintain compatibility and retain user engagement, often at the expense of fundamental technological breakthroughs. Menezes and Quiggin (2012) examined the effects of increased competition on market performance, noting that higher concentration generally results in diminished rivalry. Dufwenberg and Gneezy (2000) provided experimental evidence that the degree of price competition in concentrated industries can either distort or intensify innovative activities, driven by non-cooperative strategic behavior. An analysis of mobile telecommunications within the Organization for Economic Co-operation and Development countries conducted by Sung (2014) revealed that greater market concentration can both hinder and enhance innovation, contingent upon the prevailing regulatory framework. Newbery and Kattuman (1992) examined markets in Eastern Europe, observing that reforms in market structure significantly influence competitive behavior and innovation activities. The early theoretical underpinnings regarding concentration and competition were established by Tucker (1940), laying the groundwork for subsequent empirical investigations. Bresnahan and Reiss (1991) explored

entry barriers and competition in concentrated markets, highlighting the influence of market power on research and development strategies and overall innovation. Ahuja and Lampert (2001) explain that market pressures often prompt firms to accelerate their innovation cycles. Previous research, such as Mansfield (1968) and Henderson and Cockburn (1993), primarily addressed the quantity and intensity of innovations, there has been limited attention to innovation timing.

Lerner et al. (2004) studied how market concentration influences a firms' strategic choices and timing of innovation activities. They concluded that high competition in the market pushes firms' to opt for quicker and short-term innovation activities to stay competitive, whereas less competitive markets often facilitate long-term exploratory research and development. Yee et al. (2015) carried out research focused on assessing the relationship between market concentration and firm performance in general insurance companies in Malaysia. They observed that higher market concentration is positively associated with improvement in financial performance especially in context of leading market force who benefit from their economies of scale and market strength. They however, cautioned that exceedingly high rate of concentration may diminish competitive pressure. This in turn may potentially lead to compromise on innovation activities, which eventually impacts the choices available for consumers. This analysis affirms the complicated relationship between market dominance versus industry performance. In their research on the semiconductor industry, Chen et al. (2020) noted that mergers in the semiconductor industry resulted in an increased number of new products offering but led to a preference for incremental updates over transformative breakthroughs. These strategies of incremental updates delivered in the short-term but did not necessarily foster breakthrough innovation.

A study by Glaeser et al. (2024), offers significant insights into the combined influence of firm-specific and industry-level factors on an organization's innovation approach. He concluded that to obtain strategic advantage companies working in heavily concentrated market are more likely to opt for short-term innovations using their market power. Aghion et al. (2024), studied the impact of market size on innovation outcome and noted a varied influence. They noted that larger markets often encourage more substantial technological breakthroughs which are particularly facilitated through increased export activities. Gayle (2001) performed empirical assessment of the Schumpeterian hypothesis and discovered that an intermediate level of market concentration can foster innovation. Vossen (1999, studied the complex connection between market power, concentration, and innovation. He observed a paradox that concentration, which possibly can be considered a proxy of market power, can provide a positive effect of high R&D spending but not necessarily high overall innovation output. He concludes that although concentrated sectors may be able to trigger investments directed to innovation, the ultimate effects on actual innovative activity may even be negative. As a result, this constellation of market power per se does not necessarily imply more innovation.

Mehta et al. (2016) performed evaluation of Indian pharmaceutical industry, they noted that leading companies, occupying important positions, mainly focus on short-term innovation as a measure to maintain their leading status. These findings are consistent with those of Branch et al. (1982), who claimed that the extent of market as well as level of concentration play a key role in sharing firm performance and innovation pace. Emeran et al. (2025), went ahead on similar line and studied competitive rivalries in European airline operators, they provided a clear linkage on how market concentration affects tactical decision making. Zhao et al. (2024) adopted an empirical approach in their examination of land markets in China. They discovered that increased concentration dampens price competition which eventually impacting innovation in land development and built environment. Azman et al. (2025), conducted similar research on the construction industry in developing economies, they demonstrated regulatory intervention as the mediator between the overall impact of market concentration and productivity and direct impact on innovation.

Prior research has explored the complex relationship between market concentration and innovation, significant ambiguities remain particularly regarding how concentration shapes the timing of innovation, or the "innovation horizon." Earlier foundational work by Mansfield (1968), Griliches (1984), and Hashmi et al. (2010) emphasized how industry structure affects both the quantity and nature of innovation, yet largely focused on aggregate R&D investment or innovation rates, not the time dimension. Other studies, for example Mairesse et al. (1995) and Cockburn et al. (1987), observed that firms in highly concentrated markets often accelerate innovation cycles, but stopped short of systematically analyzing whether this results in a persistent preference for short-term versus long-term innovation strategies. Likewise, research by Chen et al. (2020) and Cusumano et al. (2019) explained that dominant firms in concentrated industries may favor incremental, rapid innovation to maintain competitive advantage, potentially at the expense of transformative breakthroughs. Despite valuable insights from Lerner et al. (2004), Ahuja and Lampert (2001), and Griliches et al. (1988) on the influence of market forces and competition on innovation timing, much of the existing literature either addresses innovation output or intensity or is limited to single industries or country contexts. The nuanced effect of market concentration on the horizon of innovation, especially across diverse U.S. industries and using robust econometric methods remains underexplored (Mazzucato, 2000; Brennan et al., 2000; Dolata, 2017; Glaeser et al., 2024). Thus, there is a clear need for systematic, cross-industry evidence on how market concentration influences whether firms adopt short-term or long-term innovation strategies, an area this study aims to address by explicitly measuring and empirically testing the link between market structure (using Herfindahl-Hirschman Index) and firms' innovation horizon.

METHODOLOGY AND DATA SOURCE

The connection between innovation horizon and market concentration in U.S. firms is best conceptualized through the lens of the Schumpeterian tradition in innovation economics, alongside modern developments in industrial organization. Schumpeter's seminal work (1942) articulates a complex interaction between market structure and incentives for innovation, contending that some degree of monopoly power may foster innovative activity by affording firms greater security and resources. However, excessive market concentration can reduce the incentive for long-term research investments, as the urgency to compete and disrupt becomes diminished. Subsequent theoretical advances, particularly those by Aghion et al. (2005), refine this perspective by demonstrating an inverted-U connection between innovation and competition in the market, explaining that moderate competition maximizes innovative activity. In industries characterized by high concentration, dominant firms are often incentivized to focus on short-term, incremental innovation rather than undertaking riskier long-term research and development projects, to safeguard established market positions. Empirical and theoretical scholarship has consistently supported the hypothesis that higher market concentration, measured using the Herfindahl-Hirschman Index (HHI), is linked with a shorter innovation horizon, as firms in concentrated industries seek more immediate returns on innovation investments (Aghion et al., 2005; Gilbert, 2006; Ali & Zulfiqar, 2018).

This model is further enriched by the inclusion of control variables drawn from the innovation management and corporate finance literature. Financial leverage, representing the extent of debt in a firm's capital structure, may constrain the willingness to engage in long-term R&D, given the heightened sensitivity to risk under high leverage (Hall, 2002). Firm size, expressed as the natural logarithm of total assets, serves as a proxy for the resource base available for innovation activities; larger firms, as indicated by Cohen and Klepper (1996), tend to pursue projects with longer payback periods, thus potentially extending the innovation horizon. Capital expenditure reflects the overall intensity of innovation investment, while cash holdings represent financial flexibility, both of which are critical in sustaining R&D efforts, particularly during periods of uncertainty (Brown & Petersen, 2009; Zhang & Wu, 2020; Wang & Chen, 2021; Dima, 2022; Denial, 2023; Audi et al., 2025). The share of revenue from core

operational segments signals the degree of strategic focus, which can influence the prioritization and timing of innovation activities.

The theoretical foundation for this analysis is grounded in the Schumpeterian view (Schumpeter, 1942), extended by the competition-innovation literature (Aghion et al., 2005) and supported by the structure-conduct-performance paradigm (Bain, 1956). Additional empirical and conceptual support is drawn from Gilbert (2006), Nickell (1996), Boone (2008), Lerner (1997), and Huergo and Jaumandreu (2004), who collectively emphasize the centrality of market structure, competitive pressure, firm resources, and financial constraints in shaping innovation outcomes. The model of our study become as:

$$\text{Innovation Horizon}_{i,t} = B_0 + B_1\ HHI_{i,t} + B_2\ \text{Leverage}_{i,t} + B_3\ \ln(\text{Size})_{i,t} + B_4\ \text{Capex}_{i,t} + B_5\ \text{Cash}_{i,t} + B_6\text{Revenue\_Percent}_{i,t} + \gamma t\ \text{Fixed Effects (Year)} + \text{Fixed Effects (Industry)} + e_{i,t}$$

Where:

i – Lists Companies

t - Time,

γt - Fixed Effects (Year)

δj – Fixed Effects (Industry)

$e_{i,t}$ - Error Term.

Innovation horizon (assesses level of innovation outcome or extent of innovation activity during a period). The time taken between investments in research & development activities and the eventual realization of innovation in form patent applications, registration of trademarks etc.,

The Herfindahl-Hirschman Index (HHI) is the standard metric used for evaluation of market concentration and thus serves as an indicator of market competitiveness. It is determined by adding squares of market shared possessed by each company within a specific industry.

Leverage reflects a firm's financial structure, specifically the proportion of debt relative to equity, and is indicative of the firm's overall financial risk exposure.

Firm Size is represented by the natural logarithm of a company's total assets or sales, a transformation that both standardizes the size variable and accounts for differences in scale across firms.

Capital Expenditure denotes the total investment made by a company in research and development or physical assets, capturing the firm's overall commitment to innovation-related activities.

Cash encompasses the liquid resources—cash and equivalents—maintained by firms, which are readily available to fund innovation projects.

Revenue refers to the share of income generated from primary or targeted business segments, highlighting the firm's main operational focus and strategic priorities.

This research relies on a substantial dataset, utilizing an unbalanced panel of U.S. firms observed over a ten-year span from 2009 to 2017, encompassing 51,944 firm-year observations across multiple industrial sectors. The data are drawn from Refinitiv and the study by Glaeser and Yoo (2024), "Is innovating risky? The effect of R&D on idiosyncratic and systematic firm risk." The use of an unbalanced panel is methodologically appropriate given the entry and exit of firms over time, thus reflecting the real dynamics of corporate activity and allowing for broader generalizability.

Outliers are addressed through Winsorization at the first and ninety-ninth percentiles, with extreme values being replaced at these boundaries, thereby mitigating the influence of outliers on the final results. As Wilcox (2011) notes, Winsorization effectively reduces the impact of extreme observations and is particularly suitable for financial data analysis.

Ordinary Least Squares regression is employed, subject to its core assumptions: linearity of parameters, independence of residuals, homoskedasticity, and the absence of perfect multicollinearity among regressors. Meeting these conditions ensures that the estimates produced are the Best Linear Unbiased Estimators, as articulated by Wooldridge (2002). The study also rigorously checks for these assumptions: multicollinearity is assessed using Variance Inflation Factors, which indicate low correlation among regressors; robust standard errors are applied to address potential violations of homoskedasticity; Winsorization is used to address linearity and functional form; and fixed effects are incorporated to control for unobserved heterogeneity and promote independence of residuals across firms and time. To further address the possibility of omitted variable bias and endogeneity, instrumental variable techniques, and relevant diagnostic tests, including Chi-squared tests, are implemented to ensure that the primary regressors, particularly market concentration, are not correlated with the error term. The modeling framework thus produces reliable and robust results based on adherence to the key Ordinary Least Squares assumptions: linearity, independence, homoskedasticity, and the absence of multicollinearity.

RESULTS AND DISCUSSION

This section contains the results and accompanying discussion. Table (1) delivers an encompassing depiction of the sector-wise distribution of industries across the United States, illustrating both diversity and concentration within the industrial profile. The evidence indicates that a handful of sectors account for a share of activity, whereas many others occupy relatively modest portions of total establishments. Chemical / Related Products appear as the largest sector, comprising 15.5 percent of all recorded industries. This dominance underscores the United States' longstanding strength in chemical production, spanning basic compounds to advanced pharmaceutical formulations; the sector's position is supported by domestic demand and export capability, as documented by the American Chemistry Council (2023). Close behind is the Business Services / Consulting sector at 14.4 percent. The substantial representation of business services aligns with broader patterns in highly developed economies, where knowledge-intensive and professional service activities increasingly propel employment and innovation (Baily and Bosworth, 2014). The prominence of Metal mining, representing 12.2 percent, further emphasizes the continuing importance of resource extraction. This proportion signals a robust domestic supply chain for metals indispensable to construction and manufacturing. By contrast, the Oil & Gas Extraction sector, accounting for 8.4 percent of establishments, remains fundamental to national energy security, even as legislative reforms, and market forces increasingly foster diversification toward renewable sources (International Energy Agency, 2023). Electronic Equipment at 7.6 percent and Measurement / Analyzing / Controlling Equipment at 6.1 percent together highlight the centrality of high-technology manufacturing to economic competitiveness, supporting domestic requirements and export performance in industrial automation and digital infrastructure (Statista, 2024). Traditional manufacturing domains, including Industrial / Commercial Machines and Metal Industry (Primary), maintain moderate shares, reaffirming that the United States's industrial base remains both extensive and resilient. Sectors such as Tobacco Goods, Textile Products, and Leather & related Goods record extremely small shares, frequently below one percent. Such marginal presence corresponds with broader trajectories of globalization, outsourcing, and evolving consumer preferences, trends that have precipitated consolidation and contraction within these industries (Gereffi and Frederick, 2010). Likewise, categories like Special Trade Contractors (Construction) and Repair Service (Miscellaneous) exemplify highly specialized or niche segments. Collectively, this multifaceted industrial landscape reflects the United States' ongoing transition toward a service-oriented and knowledge-based economy while retaining a substantial foothold in resource

extraction and manufacturing. This composition, documented extensively in scholarly analysis, characterizes developed economies that have undergone sustained industrialization, technological progression, and integration into global value chains (Porter, 1998; United States Geological Survey, 2023).

Table 1: Industry Sector wise Outlook

Industry Type	Frequency	Percent Share	Cumulative Percentage
Chemical / Related Products	8,049	15.5%	15.5%
Business Services / Consulting	7,478	14.4%	29.9%
Metal Mining	6,353	12.2%	42.1%
Oil & Gas Extraction	4,388	8.4%	50.6%
Electronic Equipment	3,964	7.6%	58.2%
Measurement / Analysing / Controlling Equipment	3,177	6.1%	64.3%
Industrial / Commercial Machines	2,322	4.5%	68.8%
Food / Kindred Products	1,417	2.7%	71.5%
Transport Equipment	1,340	2.6%	74.1%
Others (not classified)	1,080	2.1%	76.2%
Wholesale trading (durable)	1,031	2.0%	78.2%
Retail (Miscellaneous)	937	1.8%	80.0%
Wholesale trading (non-durable)	794	1.5%	81.5%
Restaurants / Cafes (Eating / Drinking areas)	719	1.4%	82.9%
Metal Industry (Primary)	685	1.3%	84.2%
Metal Products (Fabricated)	615	1.2%	85.4%
Recreation & Amusement Services	610	1.2%	86.6%
Mining / Quarrying (Non-metallic minerals)	499	1.0%	87.5%
Petroleum refining	469	0.9%	88.4%
Paper & Allied Products	442	0.9%	89.3%
Stores (Apparel & Accessories)	407	0.8%	90.1%
Apparel & Other (Finished Products)	389	0.7%	90.8%
Printing & Publishing Industry	380	0.7%	91.5%
Miscellaneous Manufacturing	369	0.7%	92.2%
Rubber & Misc Plastic items	345	0.7%	92.9%
Food Stores	300	0.6%	93.5%
Wood / Lumber products	288	0.6%	94.0%
Motion Pictures	278	0.5%	94.6%
Products (Stone / Clay / Glass / Concrete)	273	0.5%	95.1%
Contractors (General & Building Construction)	261	0.5%	95.6%
Heavy Construction Works (excluding building)	255	0.5%	96.1%
Lodging Place (Hotels, Camps etc.,)	255	0.5%	96.6%
Mining (Bituminous Coal & Ignite)	247	0.5%	97.1%

Industry Type	Frequency	Percent Share	Cumulative Percentage
Gasoline (petroleum) Service Stations & Automotive dealers	243	0.5%	97.5%
Merchandise Stores (General)	235	0.5%	98.0%
Furniture & Fixtures	223	0.4%	98.4%
Stores (Home Furniture & Equipment)	171	0.3%	98.7%
Repair, Services & Parking (Automobiles)	106	0.2%	98.9%
Special Trade Contractors (Construction)	103	0.2%	99.1%
Personal Services	102	0.2%	99.3%
Textile Products	96	0.2%	99.5%
Leather & related Goods	96	0.2%	99.7%
Building Material, Hardware etc.,	82	0.2%	99.9%
Tobacco Goods	70	0.1%	100.0%
Repair Service (Miscellaneous)	1	0.0%	100.0%
	51,944	100%	

Table (2) presents the Year Wise (2009 – 2017) Outlook, of sample data used, in the United States of America (US), offering a longitudinal perspective on industrial formation and continuity over nearly a decade. The data exhibit a striking consistency in both frequency and percentage share of industries established annually, with each year contributing approximately 11 percent to the total sample. The highest share is recorded in 2013, at 11.89 percent, while the lowest occurs in 2017, at 10.37 percent. This regularity indicates that the industrial landscape of the United States experienced a period of relative equilibrium, without substantial fluctuations in the rate of new industry formation throughout the examined timeframe. This stability is particularly notable when contextualized within the broader economic environment. The years from 2009 to 2017 encompass the post-Great Recession recovery and an extended phase of economic stabilization. The near-uniform annual figures shown in Table 2 may reflect the underlying resilience and adaptive strength of American industries, along with the impact of policy measures and economic stimuli aimed at revitalizing industrial activity (Litan and Hathaway, 2017). Previous research has demonstrated that, following the initial disruptions of the financial crisis, industrial formation in the United States progressed steadily—if modestly—as consumer confidence improved and financial systems regained normal functioning (Decker et al., 2014). An additional insight from table 2 is the absence of any dramatic increases or declines in annual industrial formation. Even in 2017, the year with the smallest representation, the share exceeds 10 percent of the sample. This distribution supports findings in the academic literature explaining that despite regional and sectoral adjustments, the broader capacity for business creation in the United States has remained robust, fueled by continuous innovation, entrepreneurial activity, and efficient resource allocation (Hathaway and Litan, 2014). The relatively balanced spread of industrial establishments across the years may further highlight the structural advantages of a large, diverse economy, which allows it to absorb external shocks and sustain cross-sectoral momentum over time.

Table 2: Year Wise Outlook

Year	Frequency	Percent Share	Cumulative Percentage
2009	5,692	11.0%	11.0%
2010	5,695	11.0%	21.9%

Year	Frequency	Percent Share	Cumulative Percentage
2011	5,681	10.9%	32.9%
2012	6,135	11.8%	44.7%
2013	6,177	11.9%	56.6%
2014	5,981	11.5%	68.1%
2015	5,678	10.9%	79.0%
2016	5,519	10.6%	89.6%
2017	5,386	10.4%	100.0%
Total	51,944	100%	

Table (3) presents a detailed summary of the descriptive statistics for the key variables associated with the industrial firms included in the study. The variable Innovation Horizon has a mean value of approximately 2.99, with a standard deviation of 0.61 and a range spanning from 1.85 to 4.14. Often interpreted as the anticipated time frame over which firms initiate and implement innovative activities, this metric explains that the typical United States firm in the sample engages in innovation over a medium-term period. Such planning horizons are consistent with existing research that underscores the importance of long-range strategic planning for sustaining competitive advantage (Christensen, 1997). The Herfindahl-Hirschman Index, a widely accepted measure of market concentration, displays mean of 0.07 with standard deviation at 0.05. The observed minimum and maximum values, from 0.02 to 0.33, explain that the average industry in this dataset is relatively unconcentrated, though some variation exists. Lower index values are indicative of competitive markets, while higher values point toward oligopolistic or monopolistic structures—a pattern reflected in contemporary assessments of industry concentration in the United States (Rhoades, 1993). The Leverage variable shows mean value 0.24 and standard deviation at 0.51 with values reaching as high as 3.92. Representing the ratio of total debt to total assets, this variation indicates that while many firms exhibit moderate leverage, some maintain substantially higher debt levels—a disparity shaped by capital structure preferences and industry-specific factors (Titman and Wessels, 1988). Firm Size, with mean of 5.01 and standard deviation of 2.76, exhibits considerable variability, ranging from as low as 0.004 to as high as 11.40. This spread captures the coexistence of both small and large firms within the United States industrial ecosystem, echoing earlier findings on firm heterogeneity and scale effects in resource utilization (Ayyagari, Demirgüç-Kunt, and Maksimovic, 2007). Capital Expenditure, another key variable, reports a mean of 0.06 with a standard deviation of 0.09, a maximum of 0.49, and missing minimum values. These statistics reflect wide variation in capital investment across firms, shaped by sectoral conditions, firm maturity, and broader macroeconomic influences (Fazzari, Hubbard, and Petersen, 1988). The variable Cash, representing the proportion of liquid assets held by firms, has a mean of 0.26 and a standard deviation of 0.28, with a maximum of 0.99. This wide range illustrates the divergent approaches to liquidity management and risk tolerance seen across industrial sectors. Maintaining sufficient cash reserves is essential for both operational agility and seizing strategic investment opportunities (Bates, Kahle, and Stulz, 2009). Lastly, Revenue shows a mean of 0.80, a standard deviation of 0.85, and a maximum of 4.43. This substantial variation aligns with prior empirical work indicating that revenue distributions are often skewed in large datasets, with a small number of large firms accounting for a disproportionate share of total earnings (Davis and Haltiwanger, 1992).

Table 3: Summarized Statistical Results

Variable(s)	Observations	Mean	Standard Deviation	Minimum	Maximum
Innovation Horizon	51,944	2.99	0.61	1.85	4.14
Herfindahl -Hirschman Index (HHI)	51,944	0.07	0.05	0.02	0.33

Leverage	51,944	0.24	0.51	0	3.92
Firm Size (Size)	51,944	5.01	2.76	0.004	11.40
Capital Expenditure (Capex)	51,944	0.06	0.09	0	0.49
Cash (Cash Holding)	51,944	0.26	0.28	0	0.99
Revenue (Percent Share)	51,944	0.80	0.85	0	4.43

Table (4) presents the correlation matrix for the primary variables under study, providing insight into the degree and direction of linear association among them. Innovation horizon is weakly and positively correlated with Revenue (0.170), indicating that firms with longer planning horizons for innovation tend to report higher revenue, a relationship supported in the innovation-performance literature (Coad, Segarra, & Teruel, 2016). Additionally, Innovation Horizon has small positive correlations with Leverage (0.06) and Cash (0.066), and a slightly negative relationship with capital expenditure (−0.146), implying that firms more focused on future innovation may hold greater cash reserves and, perhaps counterintuitively, invest somewhat less in physical assets at a given point in time. Herfindahl-Hirschman Index, a measure of industry concentration, we observe a weak negative correlation with Cash (−0.187) and very small negative or positive correlations with other variables. This pattern may explain that firms operating in more concentrated industries are less likely to hold large cash balances, possibly due to more stable competitive environments or stronger bargaining positions (O'Brien & Folta, 2009). Leverage exhibits low-magnitude correlations with the other variables, though its negative correlation with Cash (−0.099) is consistent with the idea that more highly leveraged firms tend to maintain lower cash balances, perhaps due to increased monitoring by creditors or the disciplining effect of debt (Bates, Kahle, & Stulz, 2009). Firm Size is negatively associated with Cash (−0.337), indicating that larger firms are typically less reliant on holding high cash balances, likely because they have greater access to capital markets and more predictable cash flows (Opler et al., 1999). The correlation between firm size and revenue is positive (0.123), as expected, reflecting the scale advantages enjoyed by larger firms. Capital expenditure is weakly and negatively correlated with both Innovation Horizon (−0.146) and Revenue (−0.120), which could explain that firms investing heavily in fixed assets are not necessarily those experiencing higher revenue growth in the sample period, possibly due to lags between investment and realized financial performance (Fazzari, Hubbard, & Petersen, 1988). Finally, the negative correlation between Cash and Revenue (−0.250) indicates that firms with greater revenue streams may be less inclined to hold excess liquidity, as ongoing operations generate sufficient internal funds.

Table 4: Correlation Matrix

Variable	Innovation Horizon	Herfindahl-Hirschman Index	Leverage	Firm Size	Capital Expenditure	Cash	Revenue
Innovation horizon	1						
Herfindahl-Hirschman Index	(0.07)	1					
Leverage	0.06	(0.023)	1				
Firm Size	0.04	0.07	(0.060)	1			
Capital Expenditure (Capex)	(0.146)	0.077	(0.009)	0.001	1		
Cash	0.066	(0.187)	(0.099)	(0.337)	(0.185)	1	
Revenue	0.170	0.107	0.073	0.123	(0.120)	(0.250)	1

Table 5 reports the results of a multivariate regression analysis in which innovation horizon serves as the dependent variable, while the independent variables include Herfindahl-Hirschman Index, leverage, firm size, capital expenditure, cash, and revenue. The results show that the Herfindahl-Hirschman Index is

significantly and negatively associated with the innovation horizon (coefficient = −0.93, $p < 0.01$), explaining that firms operating in more concentrated industries tend to adopt shorter innovation horizons. This finding aligns with prior literature indicating that market competition can spur longer-term innovation planning, as firms in less concentrated industries face greater pressure to differentiate over time (Aghion et al., 2005; Farahmand, 2019; Altaf & Shahzad, 2021). In contrast, monopolistic or oligopolistic environments may reduce incentives for sustained, long-term innovation. Leverage has a small but positive and statistically significant effect on innovation horizon (coefficient = 0.013, $p < 0.01$), indicating that firms with higher debt ratios are likely to plan for longer innovation cycles. This outcome may reflect the disciplining role of external finance in enforcing more strategic, future-oriented decision-making, as supported by studies on capital structure and innovation (Czarnitzki & Kraft, 2009; Turan & Can, 2024).

Firm Size is negatively associated with the innovation horizon (coefficient = −0.002, $p < 0.05$), though the magnitude is small. This relationship explains that, controlling for other factors, larger firms may pursue relatively shorter innovation horizons, potentially due to greater pressures for near-term results or inertia in decision-making (Baldwin & Lin, 2002; Broz, 2022). Capital Expenditure is strongly and negatively related to the innovation horizon (coefficient = −0.21, $p < 0.01$). This explains that firms making larger investments in fixed assets are likely to focus on nearer-term innovation, perhaps to quickly capitalize on those investments or because substantial outlays limit the scope for long-term projects (Hall & Lerner, 2010; Abbas & Uddin, 2022). Cash also shows a negative and statistically significant association with the innovation horizon (coefficient = −0.06, $p < 0.01$). Firms with greater liquidity appear to prefer shorter innovation cycles, a finding that may reflect either increased flexibility to pursue rapid innovation or a risk-averse tendency to prioritize quick returns over long-term projects (Bates et al., 2009; Konnov, 2020; Yang & Ron, 2022). By contrast, Revenue has no statistically significant effect on the innovation horizon (coefficient = −0.001, $p = 0.3$), indicating that, after accounting for the other factors and fixed effects, differences in revenue do not meaningfully predict the time frame over which firms plan their innovation activities.

Table 5: Regression Outcomes

Variable(s)	(1) Innovation horizon
Herfindahl-Hirschman Index (HHI)	-0.93***
	(-6.64)
Leverage (Gearing)	0.013***
	(3.8)
Firm Size	-0.002**
	(-2.3)
Capital Expenditure (Capex)	-0.21***
	(-9.5)
Cash (Cash Holding)	-0.06***
	(-7.97)
Revenue (Percent Share)	-0.001
	(-0.3)
Constant	2.395***
	(150.87)
Observations (Count of Firms)	51,944
R-Squared	0.63
Fixed Effects (Year)	Yes

Variable(s)	(1) Innovation horizon
Fixed Effects (Industry)	Yes
F	1,496

t - statistics in parentheses
*** p < 0.01 , ** p < 0.05 , * p < 0.1

Table (6) reports the variance inflation factor (VIF) values for all independent variables to test for multicollinearity concerns. None of the VIF values exceed the common threshold of 10, explaining that multicollinearity is not a critical issue in the regression model. Most variables fall well below a conservative threshold of 5, with only "Chemical / Related Products" (VIF = 7.3) and "Business Services" (VIF = 6.1) showing moderate multicollinearity. The average VIF across variables remains low, reinforcing the stability and interpretability of the model estimates. Therefore, the results presented in subsequent regressions are not biased due to multicollinearity.

Table 6: VIF / I/VIF Estimation to address problem of Multicollinearity

Variable(s) / Industry Sector	VIF	1 / VIF
Herfindahl-Hirschman Index (HHI)	2.9	0.347
Leverage	1.1	0.950
Firm Size	1.3	0.766
Capital Expenditure (Capex)	1.3	0.762
Cash (Cash Holding)	1.5	0.682
Revenue (Percent Share)	1.6	0.631
Industry Sector		
Chemical / Related Products	7.3	0.138
Business Services / Consulting	6.1	0.163
Measurement / Analysing / Controlling Equipment	3.1	0.319
Electronic Equipment	3.1	0.322
Oil & Gas Extraction	3.1	0.326
Gasoline (petroleum) Service Stations & Automotive dealers	2.9	0.345
Merchandise Stores (General)	2.8	0.359
Industrial / Commercial Machines	2.4	0.425
Stores (Home Furniture & Equipment)	2.2	0.452
Food / Kindred Products	1.8	0.543
Textile Products	1.7	0.580
Others (not classified)	1.7	0.603
Wholesale trading (durable)	1.7	0.605
Building Material, Hardware etc.,	1.6	0.609
Transport Equipment	1.5	0.649
Products (Stone / Clay / Glass / Concrete)	1.4	0.709
Mining / Quarrying (Non-metallic minerals)	1.4	0.738
Rubber & Misc Plastic items	1.4	0.735
Metal Products (Fabricated)	1.3	0.770

Variable(s) / Industry Sector	VIF	1 / VIF
Retail (Miscellaneous)	1.3	0.787
Lodging Place (Hotels, Camps etc.,)	1.3	0.788
Heavy Construction Works (excluding building)	1.3	0.793
Wholesale trading (non-durable)	1.3	0.799
Special Trade Contractors (Construction)	1.2	0.806
Leather & related Goods	1.2	0.806
Repair, Services & Parking (Automobiles)	1.2	0.805
Apparel & Other (Finished Products)	1.2	0.823
Paper & Allied Products	1.2	0.843
Restaurants / Cafes (Eating / Drinking areas)	1.2	0.839
Furniture & Fixtures	1.2	0.851
Metal Industry (Primary)	1.2	0.856
Tobacco Goods	1.2	0.870
Petroleum refining	1.2	0.867
Stores (Apparel & Accessories)	1.2	0.870
Recreation & Amusement Services	1.2	0.873
Wood / Lumber products	1.1	0.894
Miscellaneous Manufacturing	1.1	0.890
Food Stores	1.1	0.897
Personal Services	1.1	0.904
Printing & Publishing Industry	1.1	0.906
Contractors (General & Building Construction)	1.1	0.934
Mining (Bituminous Coal & Ignite)	1.1	0.942
Motion Pictures	1.1	0.939
Repair Service (Miscellaneous)	1.0	0.992

Table (7) explains results of the robustness check for main regression model, reaffirming the stability of the estimated relationships. The Herfindahl-Hirschman Index (HHI) remains negatively and significantly associated with innovation horizon (coefficient = -1.077, $p < 0.01$), indicating that higher market concentration may hinder innovation timelines. Capital Expenditure also shows a significant negative effect, consistent with the main findings. Leverage retains a positive and significant association, while variables such as firm size, cash, and revenue appear statistically insignificant in this robustness setting. The R-squared value of 0.669 and high F-statistic (1310) confirm strong model fit and explanatory power. Year and industry fixed effects are included to control for temporal and sector-specific heterogeneity.

Table 7: Robustness check

Variables	Innovation horizon
Herfindahl-Hirschman Index	-1.077***
	(-9.40)
Leverage	0.009**
	(2.32)

Firm Size	0.000
	(0.24)
Capital Expenditure	-0.141***
	(-7.35)
Cash	-0.004
	(-0.52)
Revenue (Percent Share)	-0.001
	(-0.29)
Constant	2.443***
	(181.92)
Observations (Count of Firms)	36,417
R-Squared	0.669
Fixed Effects (Year)	Yes
Fixed Effects (Industry)	Yes
F	1310

t - statistics in parentheses
*** p < 0.01, ** p < 0.05, * p < 0.1

Table (8) reports outcome of the regression addressing potential endogeneity concerns. The dependent variable is innovation horizon. The model includes both industry as well as year fixed effects. The Herfindahl-Hirschman index, capital expenditure, firm size, and cash are negatively associated with innovation horizon, with all coefficients statistically significant at the 1% or 5% levels. Leverage positively influences innovation horizon, while Revenue shows no significant effect. The robustness of the model is supported by an F-statistic of 1057 and an R-squared of 0.307. The endogeneity test yields a Chi-squared value of 16.039, indicating that endogeneity has been properly addressed.

Table 8: Instrument Variable Approach (Endogeneity Test)

Variables	**Innovation horizon**
Herfindahl-Hirschman Index (HHI)	-0.09***
	(-0.00)
Leverage	0.019***
	(2.68)
Firm Size	-0.002**
	(-2.09)
Capital Expenditure	-0.319***
	(-3.09)
Cash	-0.058***
	(-6.11)
Revenue (Percent Share)	0.008
	(0.98)
Constant	-0.507
	(-0.20)
Observations (Count of Firms)	51,944
R-Squared	0.307
Fixed Effects (Year)	Yes
Fixed Effects (Industry)	Yes

F	1057
Endogeneity Test (Chi 2)	16.04

Robust z - statistics in parentheses
*** p < 0.01, ** p < 0.05, * p < 0.1

CONCLUSION

The findings of this research demonstrate that market concentration, measured using Herfindahl-Hirschman Index, plays a central role in determining the time within with entities engage in innovative projects. This study establishes that increased market concentration is consistently associated with a slower pace of innovation by using advanced econometric approaches such as fixed-effects regressions analyses and instrument variable approach on a dataset of 51,944 firm-year observations from a wide range of U.S. industries between 2009 and 2017. Comprehensive and rigorous methodical checks further reinforce the reliability of these conclusions. Moreover, simultaneous application of the industry and year fixed effects is a good way of controlling unobserved heterogeneity as well as the effects of general macroeconomic conditions, while instrumental variable estimation which is supported by robust F-statistics also mitigates the potential for reverse causality. Further, endogeneity testing provides additional support for the strength of causal interpretations presented. Collectively, these measures support the conclusion that increased market concentration constrains firms' innovation horizons, prompting a shift toward short-term innovation strategies instead of long-term initiatives.

From a policy standpoint, the results offer critical insights into the ongoing discourse surrounding market structure and innovation policy. While market concentration can yield efficiency benefits and enable resource accumulation, it may also diminish incentives for radical or disruptive innovation, a concern that aligns with this study's guiding hypothesis of "concentrated market–shorter horizon." This notion is supported by existing literature and confirms that policymakers must strive to foster competitive environments conducive to both incremental and breakthrough innovation. Encouraging such balance is essential for cultivating societies that remain resilient in the face of rapid technological transformation. The evidence indicates that firms operating within highly concentrated markets tend to favor short-term strategies, often to secure immediate advantages or mitigate competitive threats. In contrast, firms in less concentrated sectors, while not immune to short-termism, are more inclined to invest in longer-term, exploratory research and development. Future studies could extend this research by examining how industry-specific characteristics, the complexity of innovation, and evolving regulatory frameworks interact to shape innovation behavior over time.

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