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Abstract

This study investigates how market concentration, specifically, the degree of competition within a sector impacts different innovation strategies, with particular emphasis on the distinction between long-term and short-term innovation approaches adopted by corporations. The research utilizes a dataset comprising an unbalanced panel of U.S based firms. To generate robust and valid conclusions, the analysis incorporates a suite of statistical and econometric methodologies, such as regression analysis, multicollinearity diagnostics, tests for endogeneity, and comprehensive robustness assessments. These tools are employed to examine the connection between market concentration, measured by the Herfindahl-Hirschman Index, and the innovation horizon, defined as the interval between initial research and development investments and the attainment of innovative outcomes. Furthermore, the robustness analyses confirm the reliability of the findings across various modeling specifications, providing empirical evidence that heightened market concentration correlates significantly with a reduced innovation horizon. The results reveal that firms operating in markets characterized by high concentration are inclined toward short-term innovation strategies, likely as a result of intense competitive dynamics among a limited number of dominant players striving to retain market share. These insights advance the understanding of how market structure shapes the strategic timing of innovation within firms, yielding important implications for innovation policy as well as managerial decision-making.

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

1. Introduction

Corporate and business practices have experienced considerable evolution and transformation over time. The sequence of industrial revolutions, coupled with the rise and decline of corporations, illustrates that companies capable of maintaining competitiveness and adapting their product

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offerings to changing circumstances are the ones that persist, while those unable to adjust ultimately disappear. Schumpeter (1934) highlighted the central role of innovation in ensuring business success and facilitating economic advancement. His analysis extensively examined the outcomes of insufficient innovation, emphasizing that organizations neglecting to innovate become obsolete and are eventually forced out of the market. Schumpeter described this phenomenon as "creative destruction," wherein emerging, innovative companies replace legacy firms to more effectively address the shifting demands of business and the marketplace. Organizations that lead today's business environment routinely invest in enhancing their products and services, striving to distinguish themselves within their respective industries. In response to varying competitive pressures, firms implement diverse innovation strategies to secure their market positions. Some businesses emphasize innovations aimed at long-term growth, while others adopt hybrid approaches according to their range of products, and some prioritize short-term achievements to ensure continued relevance and survival (Kamber and Rizzo, 2020; Aghion et al., 2005). Innovation is a key driver of economic development as it propels technological progress, reinforces corporate strength, and supports sustainable growth. Firms must thoughtfully assess both the timing and method of innovation, weighing immediate goals against longer-term aspirations. Determining the appropriate moment for introducing innovations is critical for a company's continued viability and competitive edge.

Market concentration refers to the extent to which a limited number of firms dominate a particular industry or market, capturing a significant share of total sales, production, or assets. This metric gauges the level of competition or dominance within a market. High market concentration signals that a small group of large companies exercises substantial control, typically resulting in reduced competition, increased entry barriers for new participants, and greater ability to influence pricing and innovation activities. Conversely, lower market concentration fosters more intense competition among firms, which can stimulate innovation, lead to improved pricing, and offer greater consumer choice. Assessing market concentration is therefore essential for understanding the dynamics and structure of an industry. Previous studies have identified that market concentration influences a firm's strategic behavior, including investment in research and development (Mairesse et al., 1995; Mansfield, 1968; Cockburn et al., 1996; Griliches et al., 1988), product pricing, and long-term versus short-term planning (Khan, 2022; Kamber and Rizzo, 2020; Aghion et al., 2005). Market concentration as an economic tool is an important indicator, reflecting market competitiveness. Understanding market concentration is crucial for firms when formulating marketing strategies. Both theoretical frameworks and empirical studies have demonstrated an inverse relationship between market-share concentration and efficiency, suggesting that firms tend to operate more efficiently in markets with lower concentration. Classic works by Bain (1956) as well as Collins and Preston (1969) support not only the notion of collusion but also the efficient-profitability hypothesis, which posits

that larger enterprises in more concentrated markets often achieve higher profitability due to the efficiencies associated with large-scale production.

The degree of dominance exerted by a small group of firms within an industry significantly shapes strategic business choices. This research utilizes the Herfindahl-Hirschman Index, originally developed by Herfindahl (1950), as a metric for assessing the relative size of firms within their competitive environment. The score derived from the Herfindahl-Hirschman Index offers valuable insight into both the influence held by leading companies and the overall level of competition within an industry. Prior studies indicate that competition intensity across different sectors can influence a company's incentive to enhance its products or services, although the specifics of this relationship remain contested. Some research argues that elevated market concentration can promote innovation by providing organizations with greater resources and operational stability, while other scholars contend that such concentration inhibits innovation due to diminished competition and increased risk of organizational 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 market concentration and innovation timing is complex. In concentrated markets, companies often pursue immediate innovations to maintain their positions. Firms operating in diverse market segments may invest in future-oriented innovations to gain or maintain a competitive edge (Wang & Ahmad, 2018; Margolis & Calderon, 2021; Audi et al., 2022).

The primary focus of this research is to determine whether industry concentration influences the temporal horizon of firms' innovation activities. 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. Such strategies may also serve as a precursor for future breakthrough technological developments. However, this perspective is not unanimously endorsed among economists. Research by Levin et al. (1987), for instance, underscores the need to analyze the timing of innovation to better anticipate the direction of technological progress. While the relationship between industry concentration and innovation is recognized as important, there is a relative scarcity of direct empirical investigation on this topic. Many prior studies primarily employ correlational approaches, which often fail to account for confounding variables or sector-wide influences (Audi et al., 2018; Karhan, 2019; Fatima & Zaman, 2020; Glaeser and Yoo, 2024). Their work examined the impact of research and development activities on the risks faced by firms and provided partial insights into the function of markets in shaping innovation. They also emphasized that both internal organizational dynamics and external industry conditions contribute to innovation behaviors.

This study seeks to establish how market concentration within a particular industry can account for the amount of time firms dedicate to the development of novel innovations. To this end, fixed-effects

regression models and instrumental variable techniques have been applied to evaluate whether firms in concentrated markets exhibit a preference for short-term innovation efforts. The results are intended to offer valuable guidance for managers and industry stakeholders regarding the optimal timing of innovation, as well as the influence of competition on patterns of innovative activity. By examining the interplay between market concentration, innovation strategies, and the duration required for innovation processes, this study elucidates how strategic innovation decisions are managed across various competitive contexts.

2. Literature review

The relationship between innovation and industry or market structure has been a central theme in academic inquiry, reflecting the intricate interplay between market power, competitive dynamics, and strategic innovation behavior. Schumpeterian economic theory contends that higher market concentration provides firms with greater financial resources and protects profitability, thereby enabling sustained investment in research and innovative projects over time (Schumpeter, 1934). Conversely, the structure-conduct-performance framework posits that leading firms in monopolized markets may withhold investment in innovation due to limited competitive pressures (Bain, 1956). These contrasting perspectives highlight the necessity of empirical investigation across different industries to validate their relevance. Mansfield (1968) found that less competitive industries tended to invest more in research and development, positing a positive association between market focus and innovative capacity, largely because dominant firms could allocate greater resources to continuous improvement projects. Griliches (1984) discussed how industry composition, particularly the presence of numerous firms, influences innovation. Highly concentrated industries typically engage in steady, incremental innovation, with the pace of technological progress further shaped by market age and regulatory context. While large, dominant firms supported higher research and development spending, this did not always translate into major or prolonged innovation breakthroughs. Hashmi et al. (2010) studied the international automobile industry and concluded that initial increases in market concentration encouraged innovation by enabling greater research and development investment. However, beyond a certain threshold, concentration reduced competitive pressure and could diminish the intensity of innovation.

Mairesse et al. (1995) found that companies in more concentrated French manufacturing sectors were more engaged in research and development and typically accelerated the pace of innovation development and launch. 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, in order 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 Organisation 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) examined the influence of market concentration on firms' strategic choices and innovation timing, concluding that high competition stimulates faster, short-term innovations necessary to sustain competitiveness, whereas less competitive markets often facilitate long-term exploratory research and development. Yee et al., (2015) analyzed market concentration's effect on firm performance within Malaysian general insurance companies. Their results showed that higher concentration correlates with improved financial performance, as leading firms leverage scale and market strength. Nevertheless, they cautioned that excessive concentration may diminish competitive pressure, potentially undermining both innovation and consumer choice, underscoring the complex relationship between market dominance and industry performance. Chen et al. (2020) investigated the semiconductor industry, revealing that mergers increased the number of new products but led to a preference for incremental updates over transformative improvements. Such strategies delivered short-term advantages but did not necessarily foster breakthrough innovation.

Research conducted by Glaeser et al. (2024) offers significant understanding regarding the combined influence of firm-specific and industry-level factors on innovation strategies. Their findings indicate that enterprises situated in industries with high concentration are more likely to pursue short-term innovation initiatives, a tendency primarily motivated by the pursuit of strategic advantage and the exercise of market power. According to Aghion et al. (2024), market size exerts a varied influence on innovation outcomes, as larger markets often encourage more substantial technological breakthroughs, particularly facilitated through increased export activities. Gayle (2001), through empirical assessment of the Schumpeterian hypothesis, finds that an intermediate level of market concentration can foster innovation. Vossen (1999) explores the interplay between market power and inventive activity, observing that increases in invention frequently coincide with a decline in competitive vitality.

A comprehensive evaluation of the Indian pharmaceutical industry by Mehta et al. (2016) reveals that leading firms tend to emphasize short-term innovation as a means of maintaining their dominance, corroborating the conclusions of Gale and Branch (1982), who assert that both the extent of market presence and the level of concentration significantly shape firm performance and rates of innovation. More recent analysis by Emeran et al. (2025) examines competitive strategies among European airlines, providing insights into how market concentration informs tactical choices. Zhao et al. (2024), focusing on China's land markets, determine that higher concentration diminishes price competition, thereby affecting innovation in land development and the built environment. In developing nations' construction sectors, Azman et al. (2025) demonstrate that the impact of market concentration on

innovation is mediated by regulatory intervention, with concentration directly influencing productivity.

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. More recent studies, such as 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 relationship between market structure (Herfindahl-Hirschman Index) and firms' innovation horizon.

3. Methodology and Data Source

The relationship between market concentration and the innovation horizon among 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 relationship between competition and innovation, 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, in an effort to safeguard established market positions. Empirical and theoretical scholarship has consistently supported the hypothesis that higher market concentration measured by the Herfindahl-Hirschman Index (HHI) is associated 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:

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

where

i indexes firms

t time, γt year fixed effects

δj industry fixed effects

eit is the error term.

Innovation horizon (measure of innovation output or activity degree over a period). The time delay between R&D investments and the subsequent realization of innovation outcomes such as patent filings.

The Herfindahl-Hirschman Index (HHI) serves as a standard metric for evaluating market concentration, providing an indicator of industry competitiveness. The HHI is calculated by summing the squares of the market shares held by each firm within a given 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.

4. 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 and allied 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 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 12.23 percent, further emphasises 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 and gas extraction sector, accounting for 8.45 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 and other electrical equipment at 7.63 percent and Measuring, analyzing, and controlling equipment at 6.12 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 and commercial machinery and Primary metal industries, maintain moderate shares, reaffirming that the United States industrial base remains both extensive and resilient. Sectors such as Tobacco products, Textile mill products, and Leather and leather products record extremely small shares, frequently below one percent. Such marginal presence corresponds with broader trajectories of globalisation, outsourcing, and evolving consumer preferences, trends that have precipitated consolidation and contraction within these industries (Gereffi and Frederick, 2010). Likewise, categories like Construction special trade contractors and Miscellaneous repair service exemplify highly specialised 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, characterises developed economies that have undergone sustained industrialisation, technological progression, and integration into global value chains (Porter, 1998; United States Geological Survey, 2023).

Table 1: Sector Wise Share of industries

Industry	Frequency	Percent	Cumulative
Metal mining	6,353	12.23	12.23
Bituminous coal and lignite mining	247	0.48	12.71
Oil and gas extraction	4,388	8.45	21.15
Mining and quarrying of non-metallic minerals	499	0.96	22.11
Building construction and general contractors	261	0.5	22.62
Heavy construction other than building construction	255	0.49	23.11
Construction special trade contractors	103	0.2	23.31
Food and kindred products	1,417	2.73	26.03
Tobacco products	70	0.13	26.17
Textile Mill products	96	0.18	26.35
Apparel & other finished products	389	0.75	27.1
Lumber & Wood products	288	0.55	27.66
Furniture & fixtures	223	0.43	28.09
Paper & allied products	442	0.85	28.94
Printing, publishing, & allied industries	380	0.73	29.67
Chemical & Allied products	8,049	15.5	45.16
Petroleum refining & related industries	469	0.9	46.07
Rubber & Miscellaneous plastic products	345	0.66	46.73
Leather & leather products	96	0.18	46.92
Stone, clay, glass, and concrete products	273	0.53	47.44
Primary Metal Industries	685	1.32	48.76
Fabricated Metal products	615	1.18	49.94
Industrial and Commercial machinery	2,322	4.47	54.41
Electronic and Other Electrical equipment	3,964	7.63	62.05
Transportation Equipment	1,340	2.58	64.63
Measuring, Analyzing, & controlling Equipment	3,177	6.12	70.74
Miscellaneous Manufacturing industries	369	0.71	71.45
Wholesale trade - durable goods	1,031	1.98	73.44

Industry	Frequency	Percent	Cumulative
Wholesale trade - non-durable goods	794	1.53	74.97
Building materials, Hardware, & Harden supply	82	0.16	75.12
General Merchandise stores	235	0.45	75.58
Food stores	300	0.58	76.15
Automotive dealers and gasoline service stations	243	0.47	76.62
Apparel & accessory stores	407	0.78	77.4
Home furniture and equipment stores	171	0.33	77.73
Eating & drinking places	719	1.38	79.12
Miscellaneous retail	937	1.8	80.92
Hotels, Camps, & other lodging places	255	0.49	81.41
Personal Services	102	0.2	81.61
Business Services	7,478	14.4	96.01
Automotive Repair, Services, & parking	106	0.2	96.21
Miscellaneous repair service	1	0	96.21
Motion pictures	278	0.54	96.75
Amusement and recreation services	610	1.17	97.92
Non classifiable establishments	1,080	2.08	100
Total	51,944	100	

Table 2 presents the year-wise distribution of industries in the United States from 2009 to 2017, 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 distribution

Year	Frequency	Percent	Cumulative
2009	5,692	10.96	10.96
2010	5,695	10.96	21.92
2011	5,681	10.94	32.86
2012	6,135	11.81	44.67
2013	6,177	11.89	56.56
2014	5,981	11.51	68.08
2015	5,678	10.93	79.01
2016	5,519	10.62	89.63
2017	5,386	10.37	100
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 2.998, with a standard deviation of 0.609 and a range spanning from 1.846 to 4.135. 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 a mean of 0.065 and a standard deviation of 0.053. The observed minimum and maximum values, from 0.021 to 0.326, 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 a mean of 0.241 with a standard deviation of 0.508 and values reaching as high as 3.919. 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 a mean of 5.005 and a standard deviation of 2.756, exhibits considerable variability, ranging from as low as 0.004 to as high as 11.404. 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 0.057 with a standard deviation of 0.087, a maximum of 0.492, 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 0.255 and a standard deviation of 0.278, with a maximum of 0.993. 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 0.799, a standard deviation of 0.852, and a maximum of 4.432. 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: Descriptive statistics

Variable	Obs	Mean	Std. dev.	Min	Max
Innovation Horizon	51,944	2.998	0.609	1.846	4.135
Herfindahl-Hirschman Index	51,944	0.065	0.053	0.021	0.326
Leverage	51,944	0.241	0.508	-	3.919
Firm Size	51,944	5.005	2.756	0.004	11.404
Capital Expenditure	51,944	0.057	0.087	-	0.492
Cash	51,944	0.255	0.278	-	0.993
Revenue	51,944	0.799	0.852	-	4.432

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 (0.062) 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.

Table 4: Correlation Matrix

Variable	Innovation Horizon	Herfindahl-Hirschman Index	Leverage	Firm Size	Capital Expenditure	Cash	Revenue
Innovation horizon	1						
Herfindahl-Hirschman Index	(0.071)	1					
Leverage	0.062	(0.023)	1				
Firm Size	0.037	0.069	(0.060)	1			
Capital Expenditure	(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

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 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 = −0.929, $p < 0.01$), 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 = −0.206, $p < 0.01$). This explains that firms making larger investments in fixed assets are likely to focus on nearer-term innovation, perhaps as a way 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 = −0.057, $p < 0.01$). 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 does not have a statistically significant effect on the innovation horizon (coefficient = −0.001, $p = 0.29$), 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

Variables	(1) Innovation horizon
Herfindahl-Hirschman Index	-0.929***
	(-6.64)
Leverage	0.013***
	(3.79)
Firm Size	-0.002**
	(-2.31)
Capital Expenditure	-0.206***
	(-9.54)
Cash	-0.057***
	(-7.97)
Revenue	-0.001
	(-0.29)
Constant	2.395***
	(150.87)
Observations	51,944
R-squared	0.626
Year fixed effects	Yes
Industry fixed effects	Yes
F	1496

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 & Allied products” (VIF = 7.26) and “Business Services” (VIF = 6.14) 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	VIF	1/VIF
Herfindahl-Hirschman Index (HHI)	2.88	0.3472
Leverage	1.05	0.9496
Firm Size	1.3	0.7663
Capital Expenditure	1.31	0.7616
Cash	1.47	0.6818
Revenue	1.59	0.6308
Bituminous coal and lignite mining	1.06	0.9415
Oil and gas extraction	3.07	0.3255
Mining and quarrying of non-metallic minerals	1.36	0.7378
Building construction and general contractors	1.07	0.9341
Heavy construction other than building construction	1.26	0.7930
Construction special trade contractors	1.24	0.8055
Food & kindred products	1.84	0.5427
Tobacco products	1.15	0.8703
Textile Mill products	1.72	0.5800
Apparel and other finished products	1.22	0.8227
Lumber & Wood products	1.12	0.8935
Furniture & fixtures	1.18	0.8507
Paper & Allied products	1.19	0.8428
Printing, Publishing, & Allied industries	1.1	0.9064
Chemical & Allied products	7.26	0.1378
Petroleum Refining & Related Industries	1.15	0.8665
Rubber & Miscellaneous plastic products	1.36	0.7349
Leather & leather products	1.24	0.8060
Stone, Clay, Glass, & concrete products	1.41	0.7085
Primary Metal Industries	1.17	0.8556
Fabricated Metal products	1.3	0.7697
Industrial & Commercial machinery	2.35	0.4250
Electronic & Other electrical equipment	3.1	0.3224
Transportation equipment	1.54	0.6493
Measuring, analysing, and controlling equipment's	3.14	0.3187
Miscellaneous manufacturing industries	1.12	0.8899

Wholesale trade - Durable goods	1.65	0.6049
Wholesale trade - non-durable goods	1.25	0.7989
Building materials, hardware, and garden supply	1.64	0.6093
General merchandise stores	2.79	0.3587
Food stores	1.12	0.8969
Automotive dealers & Gasoline service stations	2.9	0.3452
Apparel and accessory stores	1.15	0.8701
Home furniture and equipment stores	2.21	0.4516
Eating and drinking places	1.19	0.8389
Miscellaneous retail	1.27	0.7866
Hotels, camps, and other lodging places	1.27	0.7876
Personal Services	1.11	0.9035
Business Services	6.14	0.1629
Automotive Repair, Services, & parking	1.24	0.8050
Miscellaneous Repair Service	1.01	0.9917
Motion Pictures	1.06	0.9394
Amusement & Recreation Services	1.15	0.8731
Non classifiable establishments	1.66	0.6030

Table 7 reports the results of the robustness check for the 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	-0.001
	(-0.29)
Constant	2.443***
	(181.92)
Observations	36,417
R-squared	0.669
Year fixed effects	Yes
Industry fixed effects	Yes
F	1310

t-statistics in parentheses

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

Table 8 reports the results of the regression addressing potential endogeneity concerns. The dependent variable is innovation horizon. The model includes both year and industry 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: Addressing endogeneity

Variables	Innovation horizon
Herfindahl-Hirschman Index	-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	0.008
	(0.98)
Constant	-0.507
	(-0.20)
Observations	51,944
R-squared	0.307
Year fixed effects	Yes
Industry fixed effects	Yes
F	1057
Endogeniety test (Chi 2)	16.039

Robust z-statistics in parentheses

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

5. Conclusion

The findings of this research demonstrate that industry concentration, quantified through the Herfindahl-Hirschman Index, plays a pivotal role in shaping the timeframe within which firms engage in innovation activities. Utilizing a dataset of 51,944 firm-year observations from a wide range of U.S. industries between 2009 and 2017, and applying sophisticated econometric approaches including fixed-effects regression analyses and instrumental variable methods, the study establishes that increased market concentration is consistently associated with a slower pace of innovation. The reliability of these conclusions is reinforced by comprehensive and rigorous methodological checks. The incorporation of both industry and year fixed effects effectively controls for unobserved

heterogeneity and broader macroeconomic influences, while instrumental variable estimation—supported by robust F-statistics—mitigates the potential for reverse causality. Further, endogeneity testing provides additional support for the strength of the causal interpretations presented. Collectively, these measures support the conclusion that elevated market concentration constrains firms' innovation horizons, prompting a shift toward short-term innovation strategies rather than long-term, exploratory 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 policy-makers 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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