Is Silent R&D Productive?

by

Łukasz Krzysztof Langer

A dissertation submitted in partial satisfaction

of the requirements for the degree of

Doctor of Philosophy

in

Business Administration

in the

Graduate Division

of the

University of California, Berkeley

Committee in charge:

Professor Panos N. Patatoukas, Chair
Professor Sunil Dutta
Professor Omri Even-Tov
Professor Steven Davidoff Solomon

Summer 2022

Abstract

Is Silent R&D Productive?

by

Łukasz K. Langer

Doctor of Philosophy in Business Administration

University of California, Berkeley

In competitive markets where ideas are getting harder to find, firms have strong incentives to keep their ideas quiet. For this reason, many innovative firms do not disclose research and development (R&D) expenses even if their research efforts are very productive. I identify "silent R&D" firms as firms that operate in an innovative industry and choose not to disclose R&D as a separate line item but instead pool R&D with sales, general, and administrative (SG&A) expenses. I document that there is a significant proportion of silent R&D firms in the sample of the U.S.-listed stocks and that this proportion is stable over time at 13% on average. I show that silent R&D firms are different from missing R&D or trade secrecy firms identified in prior research and are not associated with poor disclosure quality. Finally, I find that silent R&D firms have higher future profitability at the magnitude of about 3 to 4.5 percent accumulated over the next three years. This higher future profitability is primarily due to the higher productivity of their intangible capital. This evidence suggests strongly that silence enshrouds better ideas. Using the findings from this paper, I also provide initial estimates of SG&A reclassification rates for silent R&D firms.

Dedication

I first thank my parents, Dorota and Robert Langer, and my brother Piotr Langer, for their love and for accompanying me always. I thank my family and friends in Poland, especially Andrzej Wiatr, Jarosław Wiatr and their family, my grandmothers Wieńczysława Butryn and Irena Langer, my other family members, Patryk Gniadek and his family, Jakub Bereziewicz, Tadeusz and Ada Głąbscy, Marcin Gul, Cezary Marzęda, Beata Szewczyk, and many others for their support and care. I thank my teachers from Tarnów, especially Janusz Foszcz and Zofia Kołodziej for providing the educational foundation for my future learning. I thank Oratorians from Tarnów, br. Janusz Kaźmierczak OFMCap, and Paulist Fathers from Berkeley for their commitment to my personal growth. I thank my professors and mentors at the Warsaw School of Economics, National University of Singapore, and University of California at Berkeley, especially Prof. Tomasz Berent, Prof. Marek Garbicz, Prof. Emir Hrnjic, Prof. Panos N. Patatoukas, and Prof. Paulina Roszkowska for their advice and inspiration. I thank Melissa Hacker and Lisa Sanders Villalba from the PhD Program office for their support throughout my doctoral studies. I finally thank my friends abroad, especially Byung Hyun Ahn, Monimoy Bujarbaruah, Linnan Cao, Kimberlyn George, Chew Guan Yu and Julia Lin Lixian, Jinsung Hwang, Dominik Jurek, Akhil Shetty, Young Yoon, and others, for their friendship and care at times when I am away from home.

Table of Contents

List of Figures

List of Tables

Acknowledgements

I especially thank my dissertation committee: Panos N. Patatoukas (chair), Sunil Dutta, Omri Even-Tov, and Steven Davidoff Solomon for invaluable guidance and advice. I also thank Xi Wu and Xiao-Jun Zhang for their comments. I also thank Maximilian Auffhammer and Michael Anderson for their econometric advice. I also thank PhD students: Byung Hyun Ahn, Kimberlyn George, Jinsung Hwang, Dominik Jurek, Piotr Langer, Young Yoon, and Summer Zhao for their support and helpful discussion. I also thank presentation participants at Berkeley Haas School of Business, Columbia Business School, Duke Fuqua School of Business, Harvard Business School, and Cornerstone Research for helpful discussion and feedback.

1. Introduction

Ideas, the key driver of research productivity and economic growth, are getting harder to find (Bloom et al. 2020). Therefore, firms competing for innovation may have strong incentives to keep their ideas silent, and instead allow them to translate into profits over time. One striking manifestation of silence is the absence of research and development (R&D) disclosure among innovative companies, which I refer to as "silent R&D" firms. In this paper, I examine the productivity of silent R&D firms.

For example, Visa, Inc. (NYSE: V) innovates in payments, security, and recently blockchain technologies but does not disclose R&D as a separate line item. Although Visa's SEC filings mention no R&D spending or budget, it is clear from information outside the financial statements that Visa engages in research and development. Visa Research is a dedicated corporate division of Visa that "*conducts applied research on the most challenging problems in the payment industry and provides technical thought leadership to guide the company's future*".[1] As of 2021, the company actively hires researchers, data scientists, software developers and other specialists to facilitate its research and development activity. This significant investment in human capital will not be reported as R&D expense. Instead, it will be pooled with other operating expenses. This pattern is not limited to Visa but rather extends to many other companies in innovative industries.

Innovative firms' choice whether or not to report R&D as a separate line item can be viewed in the context of classic disclosure theory. On one hand, disclosure communicates a firm's quality to the market and distinguishes it from low-quality firms (e.g., Diamond and Verrecchia 1991). Accordingly, there exist pricing benefits to disclosing more R&D (e.g., Lev and Sougiannis 1996, Aboody and Lev 1998, Chan et al. 2001, Cohen et al. 2013, Hirshleifer et al. 2013). On the other hand, firms optimally choose to disclose less in the presence of proprietary costs, and the optimal level of disclosure decreases as proprietary costs increase (Verrecchia 1983). When innovation is existential and ideas are scarce, the cost of R&D disclosure may outweigh the benefits of disclosure. These economic incentives for silence will increase not only with the scarcity of ideas but also with the quality of the ideas the innovator finds.

I define silent R&D firms as firms that operate in an innovative industry and choose not to disclose R&D as a separate line item but instead pool it with other operating expenses. Based on this definition, I screen for silent R&D firms and examine the association between silence and future operating performance. In competitive markets where ideas are scarce, the ideas with the most potential to improve a firm's prospects will be especially valuable. I expect silent R&D firms to be more productive, given that firms with access to the most valuable ideas face the strongest economic incentives to stay silent. I predict that this higher productivity will be driven by the intangible capital, which reflects accumulated investment

[1] See Visa Research website.

in innovation. For silent R&D firms, this investment includes R&D investment reclassified as sales, general, and administrative (SG&A) expense.

I identify 2,380 silent R&D companies, encompassing on average 13% of the sample of U.S.-listed firms. This constitutes on average 31% of missing R&D firms. The frequency of silent R&D firms is stable over time. Across industries, the frequency of silent R&D firms is lower in the industries where almost all companies report R&D (e.g., Semiconductor industry) and higher in industries where 50-60% of companies report R&D (e.g., Consumer Services industry).

I measure capital, investment, and profitability using reported data adjusted for R&D and SG&A investment. The adjusted measures reflect capitalization, rather than expensing, of the intangible investment. I also accumulate future operating profitability over the next three years to capture the improvement in profits over time. I measure intangible investment productivity as the coefficient on the intangible investment in the regression of future profitability. This way, intangible productivity can be interpreted as a rate at which an additional dollar of intangible capital is converted into future profitability.

Focusing on firm performance, I document that silent R&D firms have higher future operating profitability, at the magnitude of 3 to 4.5 percentage points accumulated over the next three years, on a per-dollar-of-capital basis. Based on the average capital in the silent R&D firms, this estimate translates to $31.4 to $52.6 million in additional profit. This outperformance is driven by a combination of higher sales growth and higher operating margins and does not depend on the choice of the performance benchmark. Tracing the sources of superior performance, I find that the rate at which intangible investment translates into future profitability is incrementally higher for silent R&D firms. This higher productivity of intangible capital explains the profitability difference between silent and non-silent R&D firms.

Silent R&D disclosure is different from secrecy disclosure examined in prior research. Following Glaeser (2018), I identify secrecy disclosure firms as firms that explicitly mention reliance on trade secrecy in their annual 10-K. I show that there is little overlap between the 10-K secrecy and silent R&D firms and that the outperformance of silent R&D firms is not driven by 10-K secrecy firms. Instead, I find that silent R&D firms have higher future profitability and higher productivity of intangible investment among firms with and without 10-K secrecy mentions. This finding implies that the two dimensions of secrecy are mostly orthogonal to each other.

Prior literature has utilized patenting as a signal for innovation. However, Silent R&D does not necessarily entail patenting. Although many companies without R&D disclosure do patent (Koh and Reeb 2015), silence and patenting are mostly mutually exclusive due to tradeoffs implicit in disclosure decisions. Silent R&D firms strategically choose not to disclose information regarding innovation, whereas patenting requires disclosure of innovation. Moreover, a large part of silent R&D firms' innovation relates to process innovation, which is not patentable (Hall et al. 2014). This innovation is usually included as a part of the SG&A expense (Lev and Radhakrishnan 2009). Accordingly, I find that silent

R&D firms patent less and that the effect of silence on profitability is concentrated in the non-patenting subsample. This result is also in line with evidence in Glaeser et al. (2020) showing that firms with long-term horizons will choose nondisclosure rather than patenting.

To the extent that not reporting R&D is a firm's strategic disclosure choice, silent R&D should not reflect poor overall disclosure. Consistent with the proprietary cost hypothesis, prior literature finds that disclosure quality is generally lower in more competitive, concentrated industries (Ali et al. 2014). Therefore, the productivity of silent R&D could be related to lower disclosure quality. To test whether the association between silent R&D and future profitability varies with disclosure quality, I run a cross-sectional test using Chen's et al. (2015) disaggregation quality (DQ) score, which measures disclosure quality based on the completeness of 10-Ks. I find that silent R&D firms have higher future profitability and higher productivity of intangible investment across disclosure quality partitions. Because the proprietary cost of disclosure is especially high for R&D, firms can choose not to disclose R&D regardless of the overall level of disaggregation quality.

Because silent R&D firms do not disclose R&D as a separate line item but instead pool it with other expenses, these firms should have higher levels of SG&A. Consistent with this, I show that silent R&D firms have higher SG&A expense than non-silent R&D firms. Further, I narrow down the definition of silent R&D firms based on the level of *abnormal* SG&A, defined as reported SG&A less expected SG&A, and find that the outperformance of silent R&D firms is driven by the firms that are more likely to be pooling R&D with SG&A. The future profitability is highest for silent R&D firms with material levels of abnormal SG&A.

Examining associations between abnormal SG&A and productivity is indirect evidence of pooling because it is unclear what the level of SG&A should be in the absence of the reclassification problem. Therefore, I also search for market-based evidence of pooling. Based on the prior literature, the primary predictor of investment, including physical and intangible components, is the ratio of the market value of capital to the replacement cost of capital, known as Tobin Q (Peters and Taylor, 2017). Using investment-Q regressions, I show that silent R&D firms have significantly higher SG&A investment and that SG&A investment in silent R&D firms is more sensitive to variation in investment opportunities as measured by Tobin's Q. These findings are consistent with pooling the R&D investment with SG&A expense.

Total investment consists of both physical and intangible investment components, where physical investment refers to investment in property' plant, and equipment (PP&E), and intangible investment refers to investment in balance sheet intangibles, plus R&D and SG&A investment. I find that total investment is more productive in silent R&D firms and that this higher productivity explains the profitability difference between silent and non-silent R&D firms. By decomposing total investment into tangible and intangible components, I show that higher profitability and higher investment productivity of silent R&D firms are driven primarily by intangible investment, although physical investment is also marginally more productive in silent R&D firms.

Finally, I estimate the SG&A reclassification rate that would explain the profitability difference between silent and non-silent R&D firms. I find that the reclassified R&D investment in silent R&D firms at the level of 41% of SG&A expense would explain the profitability difference between silent and non-silent R&D firms. This translates to the average level of reclassified R&D investment at $113.0 million annually per silent R&D company or 10.4% per dollar of sales. I also provide industry-specific estimates of the reclassification rates that vary between 24% in Food & Staples Retailing industry to 53% in Pharmaceuticals, Biotechnology, & Life Sciences and Software & Services industries.

This paper contributes to the literature on disclosure and innovation by establishing a link between not reporting R&D and intangible productivity. Consistent with the proprietary cost hypothesis, forgoing the benefits of granular R&D disclosure is justified if the firm has access to especially valuable innovation. My results show that silent R&D firms have higher future profitability and that this higher profitability is driven by higher productivity of their intangible capital. In that sense, silence enshrouds better ideas.

In addition, my paper adds to the existing literature as follows. First, I show that patenting is an incomplete measure of productivity when R&D is missing. I add to the evidence presented in Koh and Reeb (2015) by showing that silent R&D firms have higher future profitability and are less likely to patent. Second, I show that simple screening criteria suffice to identify outperforming silent R&D firms because the choice to not disclose R&D is not random but rather reflects the underlying firm characteristics. Specifying a complete selection model is, however, beyond the scope of the paper and constitutes an interesting avenue for future research. Third, silent R&D is different from other dimensions of secrecy identified in prior research. In particular, I show that secretive firms can be identified based not only on their 10-K disclosure (Glaeser 2018), but also based on their lack of R&D disclosure in their 10-Ks. Fourth, not reporting R&D is different from having overall low-quality disclosure characterized by the absence of other granular income statement and balance sheet items (Ali et al. 2014). Fifth, my results imply that some intangible productivity will be missing from any analysis that focuses only on reported R&D. This is important given concerns about the scarcity of good ideas and low research productivity (e.g., Bloom et al. 2020). Sixth, I contribute to the growing literature on measuring intangible capital (Peters and Taylor 2017, Ewens et al. 2020, Iqbal et al. 2021) by showing that the in absence of disclosed R&D, innovating firms will pool the investment in knowledge capital with SG&A expense.

Section 2 presents a study background. Section 3 provides a detailed description of the methodology and data. In Section 4 I present and discuss my empirical results, focusing on the profitability and productivity of silent R&D firms, measurement, and relation to prior research. Section 5 concludes.

2. Background

2.1. Ideas are getting harder to find

Research and development (R&D) investment and its co-investment in product design, marketing, and organizational development were linked to productivity at both macroeconomic (e.g., Oliner and Sichel 2000) and microeconomic level (e.g., Wernerfelt 1984, Lev 2001). Corrado, Hulten and Siegel (2005, 2009), and Corrado and Hulten (2010) document a major shift in the composition of investment and capital towards the intangible components. Intangible investment and capital have been a major driver of growth.

This growth arises from people creating ideas. Unfortunately, ideas are getting harder to find. In the seminal paper, Bloom et al. (2020) show that growth is a product of the (increasing) effective number of researchers and the (falling) research productivity. They give the example of Moore's law: to hit the target of doubling the number of transistors in a computer chip, the number of researchers increased 18-fold since early 1970s, implying a decrease in research productivity at a rate of about 7 percent per year. This anecdotal evidence is consistent with declining R&D productivity reported in Kortum (1993), Kogan et al. (2017), and Bloom et al. (2020), among others. It is also consistent with the weakening link between R&D investment and future profits at the firm level (Curtis et al. 2020).

Ideas getting harder to find means that protecting valuable innovation is more important than ever. Good ideas are scarce, so innovators who find such ideas might reasonably choose to keep them silent. In surveys, managers report that secrecy is a more effective intellectual property mechanism than formal methods such as patenting (Harabi 1995, Cohen et al. 2000, Arundel 2001, Jankowski 2012). The economic incentives for secrecy will increase with the scarcity of ideas and with the quality of the ideas the innovator finds. This is because formal intellectual property protection mechanisms will not grant sufficient protection of major innovations that are new to the market (Anton and Yao 2004, Bhattacharya and Guriev 2006, Hall et al. 2014). Therefore, the best ideas will be kept secret, especially in an economic environment where ideas are getting harder to find.

2.2. Silent R&D firms

Corporate secrets are secret by definition. Therefore, tracing secret innovation is difficult because many firms will intentionally conceal ideas to protect their intellectual property. Nevertheless, this corporate silence is, *ipso facto*, a clue that the firm is possibly concealing valuable innovation. Insufficient R&D disclosure, and especially lack of specific R&D disclosure, can be a strong manifestation of secrecy in the innovative industries.

The anecdotal evidence already suggests that major innovation will escape R&D disclosure. As Rajgopal (2021) points out, companies like Amazon or Apple will keep R&D reporting at an absolute minimum so that it is impossible for market participants to learn anything from this disclosure. Moreover, there will be innovative companies with no R&D disclosure at all. For example, Visa, Inc. (NYSE: V) innovates a lot in the payments, security, and recently blockchain technologies, as evidenced by the Visa technology itself, hundreds of patents, and business descriptions in the 10-K filings. However, the company does not disclose R&D as a separate line item, nor does it provide a discussion of R&D that would allow separating R&D disclosure from other line items. Another example is Aetna, Inc., a health information technology company that again is not disclosing R&D as a separate line item. Interestingly, Aetna was acquired in 2018 by CVS Health (NYSE: CVS), and one of the motivations for the acquisition was to access Aetna's innovative capabilities. Recently-listed

Robinhood Markets, Inc. (NASDAQ: HOOD) is a major disruptor in the trading industry that disclosed no R&D in the S-1 registration statement.

Prompted by anecdotal evidence of innovative activity in the absence of disclosed R&D, in this paper I focus on silent R&D firms. Silent R&D firms are firms that operate in an innovative industry and do not disclose R&D as a separate line item but rather pool it with other expenses. Accordingly, to identify silent R&D firms, I require that the firm: (1) operates in the R&D-reporting industry, (2) has missing R&D expense, and (3) has positive SG&A expense. R&D-reporting industries are industries where the majority of firms report R&D. Firms operating in R&D-reporting industries will be more likely to report R&D themselves as they employ disclosure practices that are common among their industry peers (Dye and Sridhar 1995). Furthermore, R&D-reporting industries will have high R&D intensity because R&D reporting requires the R&D investment to pass a materiality threshold. Within the R&D-reporting industries, I focus on firms that do not report R&D as a separate line item. Koh and Reeb (2015) observe that many missing R&D firms are very innovative, as demonstrated by their patenting activity. Unlike Koh and Reeb (2015), I do not restrict silent R&D firms to patenting firms only because much of the innovation will be unpatented and better protected with secrecy (Reeb and Zhao 2020, Beneish et al. 2021). Further, using patent data can be problematic due to truncation bias and other issues (Lerner and Seru, 2017). Instead, I require that silent R&D firms have positive SG&A expense. Because silent R&D firms will innovate despite missing R&D, investment in R&D will be pooled with SG&A expense. Also, even in the absence of R&D classification shifting, positive SG&A expense will reflect investment in the organizational capital. The investment in organizational capital includes investment in process innovation, design, marketing, and customer support, among other things. Such investment will be particularly relevant to non-patenting firms because much of the organizational innovation is not patentable (Hall et al. 2014).

The three criteria are an empirical proxy for unobservable silence. I use these criteria to screen for silent R&D firms and answer the following research questions. First, what is the prevalence of silent R&D firms over time and across industries? Second, how is silence different from other dimensions of secrecy studied in prior literature, such as trade secrecy firms or missing R&D firms? Finally, what is the association between silence and firm characteristics, in particular future operating performance? In competitive markets where ideas are getting harder to find, the ideas with the potential to improve a firm's prospects will be especially valuable. Given strong economic incentives to stay silent when the firm has access to such ideas, I expect silent R&D firms to be more productive.

It is important to note that the relationship between pooling of R&D with SG&A expense and future profitability and productivity can arise even in absence of the competitive forces. Instead, it can result from the information asymmetry between the firm and market participants. Jiang et al. (2021) propose a disclosure model in which managers are better informed than investors about the uncertain benefits to corporate investment. In their model, pooling of investment with operating expenses is the preferred accounting choice only when the market perception of the expected future benefits to investment is high or the uncertainty in those benefits is high. This result arises because under separate reporting (when accounting system separates investment from operating expenses), firms rationally overinvest as in classic signaling equilibrium of Spence (1974). Under pooled reporting regime, firms have incentives to both overinvest (due to signaling) and underinvest (due to market's inability to distinguish investment from expense, which discourages new investment). The magnitude of over- and underinvestment incentives in the pooled reporting regime depends on the parameters of profitability distribution as assessed by the market. Larger uncertainty in profitability of new investment makes firm's pooled expense less informative about profitability and more informative about the level of investment, which encourages investment. Higher perceived expectation of profitability also encourages investment because at higher levels of profitability any distortions in investment become more costly. Together, if market perception of the expected future benefits to investment is high or the uncertainty in those benefits is high, firm will face stronger incentives to overinvest. Therefore, firm will prefer pooled reporting regime because it weakens costs associated with overinvestment thanks to market's inability to distinguish investment from operating expense.

2.3. Secretive disclosure in prior literature

Whether to report on R&D investment is a disclosure decision. Beginning with Grossman (1981) and Milgrom (1981) revelation principle, a long line of economics and accounting research has recognized the benefits of full disclosure. The key economic argument is that more disclosure can lower adverse selection costs and the cost of capital to finance investment (Diamond and Verrecchia 1991, Botosan 1997, Healy et al. 1999, Leuz and Verrecchia 2000). In the context of innovation, more disclosure allows firms to avoid duplicate research and produce follow-on innovation. As stressed by endogenous growth theories, knowledge spillovers are essential for sustained economic growth (Romer 1990). However, information about the scope of R&D investment or any other information about innovative efforts will be highly proprietary for many intangible-intensive firms. The main concern is that competitors will use the disclosed information to invent around the patent or surpass the invention in quality (Horstmann et al. 1985, Scotchmer 1991). In the presence of the proprietary cost, a firm can optimally choose to disclose less, and the level of the firm's disclosure decreases as the proprietary cost increases (Verrecchia 1983). If the costs of innovation disclosure outweigh the benefits thereof, firms will reasonably choose to protect their inventions with secrecy.

Consistent with the proprietary cost hypothesis, Glaeser (2018) finds that firms who rely on secrecy to protect their innovation decreased proprietary information disclosure following the Uniform Trade Secrets Act (UTSA). Similarly, Li et al. (2018) show that higher trade secret protection granted by the Inevitable Disclosure Doctrine (IDD) was associated with the higher proprietary cost of disclosure and, therefore, less disclosure. The evidence presented in these papers supports the idea that secretive firms withhold information related to their innovative effort when the cost of disclosure is high, that is, when the innovation is particularly valuable. Importantly, this evidence of the decrease in proprietary disclosure due to secrecy is not equivalent to the decline in the underlying innovative activity. For the sample of high-tech firms that report R&D, Png (2017) documents increases in R&D activity in the states that granted additional trade secrecy protection following UTSA.

Prior literature has relied on the textual analysis to measure secrecy at the firm level. In particular, Glaeser (2018) uses 10-K mentions of trade secrets as an indicator of secretive firms. For example, in the 10-K for the fiscal year ended December 31, 2020, Alphabet (NASDAQ: GOOGL) disclosed: "*we also seek to maintain certain intellectual property as trade secrets. The secrecy of such trade secrets and other sensitive information could be compromised, which could cause us to lose the competitive advantage resulting from these trade secrets.*" However, secretive firms will likely avoid any additional disclosures that might betray their secrets for the same reasons they avoid providing R&D disclosures. Therefore, there will be many silent R&D firms without other disclosure about secrets or innovation in general. One contribution of this paper is to identify secretive firms based not on what they disclose but based on what they *do not* disclose.

3. Research Design

3.1. Sample and data

My sample construction starts with Compustat data available between 1980 and 2020 merged with Peters and Taylor's (2017) intangible capital database available from WRDS. The sample period begins in 1980 when R&D was commonly reported (see Peters and Taylor 2017, Curtis et al. 2020). Because intangible capital data ends in 2017 (for some companies in 2016), I complete the coverage up to 2020 using the algorithm described in Appendix B of Peters and Taylor (2017). I then require non-missing information about sales, profits, and assets, as well as GICS industry membership. I also require information about sales and profits for up to three reporting periods out. This step restricts my sample to 1980-2017 period, due to three-year out requirement. I then require positive market and book value of equity, sales, and net operating assets. Next, I exclude firms in the financial (GICS sector 40), real estate (GICS sector 60) and utilities (GICS sector 55) sectors. In the final step, I trim extreme values of key profitability and investment variables at the top or bottom percentile to mitigate the effect of extreme values and small scale. I also remove missing observations of key variables. I summarize sample construction steps in Appendix 1.

3.2. Measuring capital, investment, and profitability

The market treats R&D as an asset even though it is usually immediately expensed for reporting purposes (e.g., Lev and Sougiannis 1996; Aboody and Lev 1998; Chan et al. 2001, Gu et al. 2021). Khan et al. (2018) list the standard of expensing R&D among the standards that impair shareholder value the most. Because accounting rules on intangibles usually fail to reflect the economics of the intangible investment, the existing literature calls for updating of these accounting standards (e.g., Lev 2019). Against this background, I undo the immediate expensing of intangible investment by adjusting balance sheet capital, investment, and profitability measures. The adjusted measures reflect capitalization, rather than expensing, of intangible investment.

To measure capital, I begin with net operating assets defined as the sum of book value of equity, preferred equity, and debt. Then, I adjust net operating assets to include capitalized value of R&D and SG&A investment using Peters and Taylor's (2017) data on the internally developed, off-balance sheet knowledge and organizational capital. Knowledge capital is capitalized value of R&D investment, accumulated since company inception and amortized over time using R&D depreciation rates from the Bureau of Economic Analysis (BEA). Similarly, organizational capital is capitalized value of the fraction of SG&A investment.

I measure intangible investment comprehensively as a sum of balance-sheet intangible investment, R&D investment in knowledge capital, and SG&A investment in organizational capital:

$$IntInv_{it} = \frac{\Delta Intan_{it} + Am_{it} + R\&D_{it} + \lambda SG\&A_{it}}{K_{it-1}} \tag{1}$$

where $\Delta Intan_{it}$ is a change in balance sheet intangibles, Am_{it} is as-reported amortization, $R\&D_{it}$ is R&D investment, λ is a fraction of SG&A expense that constitutes an investment in organizational capital, $SG\&A_{it}$ is SG&A expense, and K_{it-1} is beginning-of-period capital.[2] Following Peters and Taylor (2017), in my main tests I assume $\lambda = 0.3$, meaning that 30% of SG&A investment constitutes an investment in organizational capital. I compare the alternative capitalization schemes in Section 4.3.2. By virtue of accounting identities, my intangible investment measure equals change in the intangible capital before amortization divided by beginning-of-period capital. I compare the alternative investment rates in Section 4.3.3.

Finally, I measure profitability as operating profit adjusted for the off-balance sheet intangible investment per dollar of beginning-of-period capital:

$$Profitability_{it} = \frac{OP_{it} + R\&D_{it}^{am} + \lambda SG\&A_{it}^{am}}{K_{it-1}} \tag{2}$$

where OP is operating profit after depreciation and amortization, $R\&D^{am}$ is R&D investment after amortization of knowledge capital, λ is a fraction of SG&A expense that constitutes an investment in organizational capital, $SG\&A^{am}$ is SG&A expense after amortization of organizational capital, and K_{it-1} is beginning-of-period capital. I present definitions of key variables in Appendix 2.

[2] With respect to SG&A, Compustat often reports missing SG&A values with the data code 4 to indicate that SG&A was pooled with other expenses. To mitigate this data limitation, I supplement Compustat data with FactSet data, which provides a better coverage of SG&A in cases where SG&A is pooled as part of other line items. This substitution applies to 5.1% of sample observations (encompassing 1,377 sample companies). Similarly, I also use FactSet data to supplement Compustat's missing R&D data, but this only applies to 0.8% of sample observations (encompassing 414 sample companies). For companies where Compustat data was replaced with FactSet data, I use perpetual inventory method as in Peters and Taylor (2017) to also calculate stocks of the capitalized off-balance sheet knowledge and organizational capital.

3.3. Measuring intangible productivity

In competitive markets where ideas are getting harder to find, the ideas with the potential to improve a firm's prospects will be especially valuable. Given strong economic incentives to stay silent when the firm has access to such ideas, I expect silent R&D firms to be more productive.

To test this hypothesis, I first examine the future profitability of silent R&D firms. Here, the assumption is that if silent R&D firms have access to valuable ideas, the future profitability should be higher than that of non-silent firms. My main measure of future profitability is future profitability accumulated over the next H years as follows:

$$Profitability_{it+1,t+H} = \frac{\sum_{h=1}^{H}(OP_{it+h} + R\&D_{it+h}^{am} + \lambda SG\&A_{it+h}^{am})}{K_{it-1}} \tag{3}$$

In my baseline regressions, I measure future profitability over the next three years ($H = 3$), that is, accumulated over a period from $t + 1$ to $t + 3$. Prior literature estimated that the average lag between intangible investment and commercialization varies between 1.2 to 2.5 years depending on the product group (Pakes and Schankerman 1984), and BEA uses a 2-year lag (Li and Hall 2020).[3]

Next, I link future profitability to the productivity of intangible investment using the following regression:

$$Profitability_{it+1,t+3} = \beta_1 I(Silent\ R\&D_{it}) + \beta_2 IntInv_{it} + \beta_3 I(Silent\ R\&D_{it}) \times IntInv_{it} + \sum_{k=4}^{K} \beta_{kt} C_{it}^{k} + \gamma_j + \delta_t + \varepsilon_{it} \tag{4}$$

Here, $Profitability_{it+1,t+3}$ is future profitability accumulated over a period from $t + 1$ to $t + 3$, $I(Silent\ R\&D_{it})$ is an indicator for silent R&D firms, and $IntInv_{it}$ is the intangible investment. Here, β_1 coefficient measures the relative performance of silent R&D firms and β_2 coefficient measures productivity of the intangible investment, or the rate at which intangible investment translates into future profitability. The coefficient on the interaction term, β_3, measures incremental intangible productivity of the silent R&D firms, that is, a differential rate of converting a dollar of intangible investment into future profitability for silent R&D firms. A positive β_1 coefficient would imply that silent R&D firms are more profitable, while a positive β_3 coefficient would imply that silent R&D firms have higher productivity of intangible investment. Estimating elasticity of output with respect to

[3] In additional analysis, I repeat my tests for shorter ($H = 1$) and longer ($H = 5$) horizons (using a smaller sample) and I find consistent results. Alternative horizon lengths are also part of my analysis reported in Figures 3 and 4.

intangible investment is a common approach to measuring intangible productivity, both at macro- and microeconomic levels (Hall et al. 2010).

To control for potential confounders, I include control variables, C_{it}^{k}. The vector of controls includes contemporaneous profitability, $Profitability_{it}$, to control for pre-existing differences in profitability and well-known mean reversion in profitability (Stigler 1963, Fama and French 2000). Also, I include natural logarithms of firm size, $log(MV_{it-1})$, and age, $log(age_{it})$, to control for firm scale and maturity, beginning-of-period leverage, $Leverage_{it-1}$, to control for the impact of capital structure on firm performance and for the correlation between capital structure and secrecy (Klasa et al. 2018), and beginning-of-period total Q, Q_{it-1}, which is correlated with both profitability and investment. Finally, I include industry fixed effects to control for industry-specific, time-invariant factors (γ_j), as well as year fixed-effects to control for year-specific, firm-invariant factors (δ_t).[4] I use Global Industry Classification Standard (GICS) 4-digit industry groups to classify firms into industries.[5]

4. Empirical Results

4.1. Summary statistics

In Figure 1, I present the annual frequencies of silent R&D firms. Silent R&D firms are firms that operate in innovative industries and choose not to disclose R&D as a separate line item but instead pool it with other operating expenses. The frequency of silent R&D firms is stable over time at around 13% of the sample of U.S.-listed companies, or at 31% of all missing R&D firms in the same sample. Silent R&D firms are a subset of missing R&D firms because many missing R&D firms will not operate in innovative industries where R&D reporting is common. The overall frequency of missing R&D firms is on average 42%, which means that 58% of firms report R&D. I also note an increase in R&D reporting at the magnitude of around 5 percentage points around year 2000, which was likely related to the dot-com bubble and the introduction of the Sarbanes-Oxley Act of 2002.

In Figure 2, I present frequencies of silent R&D firms across industries. The frequency of R&D reporting firms varies from around 4% in the Transportation industry at the bottom of the figure to 98% in the Semiconductors and Semiconductor Equipment industry at the top of the figure. To identify silent R&D firms, I zero in on industries where the majority of the firms report R&D. These are the industries where more than 50% firm-year observations

---

[4] I include industry fixed effects because profitability (Soliman 2003), R&D reporting practices (Dye and Sridhar 1995), and incentives to keep innovation secret (Scotchmer 1991) all vary significantly across industries. Also, my results are robust to inclusion of industry-year fixed effects, which control for industry-level trends (as opposed to time-invariant differences between industries). I do not include firm fixed effects because most of the variation in silence is between (and not within) firms, based on the analysis of variance (ANOVA). Nevertheless, my results on intangible productivity are robust to the inclusion of firm-fixed effects.

[5] Bhojraj et al. (2003) document GICS outperform other classifications, including the Standard Industrial Classification (SIC) codes, the North American Industry Classification System (NAICS) codes, and the Fama and French (1997) classification, in terms of identifying comparable companies.

have non-missing R&D.[6] Eleven out of twenty industries qualify above that threshold. Because silent R&D firms choose not to disclose R&D as a separate line item but rather pool it with SG&A, the frequency of silent R&D firms is negatively correlated with the frequency of R&D-reporting firms across industries. For this reason, I observe relatively fewer silent R&D firms in the industries where almost all firms report R&D, and relatively more silent R&D firms in the industries where 50-60% of firms report R&D.

In Table 1 Panel A, I present empirical distributions of key variables in the pooled sample. The average company in the sample generates 1.14 dollars of sales in the current period per dollar of capital, and 4.19 dollars of sales over the next three years. In terms of profitability, the average company generates 10 cents of operating profits in the current period per dollar of capital, and 36 cents of operating profits over the next three years. There is a significant variation in operating profitability in the sample: the three-periods-out profitability varies from -173% to 347%, with a standard deviation of 56%. Per dollar of capital, the average R&D is 3 cents, SG&A is 22 cents, and intangible investment is 11 cents, which consists of 2 cents of balance sheet intangible investment, 3 cents of R&D investment, and 6 cents of SG&A investment (a fraction of SG&A expense). Average $log(MV)_{it}$ is 5.15, indicating that the average company has a market capitalization of $173 million. Average $log(age)_{it}$ is 2.84, indicating that the average company is operating for 17 years since founding. The average debt-to-capital ratio is 0.214 and the average total Q is 1.42. The average frequency of silent R&D firms in the pooled sample is 13%.

In Table 1 Panel B, I report the two-sample comparison for silent and non-silent R&D firms. The average sales (operating profits) are 44 cents (2 cents) higher for silent R&D firms in the current period, and 1.72 dollars (8 cents) higher over three periods out horizon. The implied difference in future profitability is thus 8%. Consistent with cost pooling, the reported R&D is zero for silent R&D firms, whereas their SG&A expense is significantly higher than that of non-silent R&D firms. Interestingly, the total level of intangible investment is comparable between the two types of companies. Finally, the average silent R&D firm is smaller than the average non-silent R&D firm, and it has higher leverage and lower total Q.

In Table 2, I report correlations between key variables. First, contemporaneous sales and profits are positively correlated with future sales and profits. Also, there is a significant positive correlation between sales and profits over either period. The intangible investment is positively correlated with current and future sales and operating profits and total Q, but negatively correlated with size, age, and leverage. Consistent with the two-sample

[6] Additional analysis reveals that the proportion of R&D-reporting firms correlates strongly with intangible intensity across industries. This correlation arises because R&D reporting requires that R&D investment passes a materiality threshold. Indeed, whereas the average R&D-to-sales ratio in the R&D-reporting industries increased from about 2.4% in 1980 to 35.5% in 2017, it remained constant at about 1.7% for the non-R&D-reporting industries.

comparisons in Table 1, the silent R&D indicator positively correlates with current and future sales and operating profits.

4.2. Intangible productivity of silent R&D firms

4.2.1. Future performance

In Figure 3, I present the abnormal performance of silent R&D firms. The figure illustrates profitability in the current year ($t = 0$) and then accumulated over the next $H = 1, \dots, 5$ fiscal years, all relative to beginning-of-period capital at $t = 0$. Thus, the figure represents an average pattern of profitability evolution over the next five years. The profitability is presented relative to industry-year means. This adjustment helps to track the firm's performance relative to annual industry benchmarks. The evidence in Figure 3 is consistent with the outperformance of silent R&D firms: the industry-year-adjusted profitability of silent R&D firms is increasing from less than 1% in the current period to about 6% over the five-periods-out horizon. In contrast, non-silent R&D firms underperform the industry-year benchmarks: the industry-year-adjusted profitability of non-silent R&D is decreasing from around 0% in the current period to almost -2% over the five-periods-out horizon. The combination of outperformance of silent R&D firms and the underperformance of non-silent R&D results in the spread in profitability between the two types of firms that increases with the length of the accumulation period.

In Table 3, I report the results of profitability regressions. Column (1) shows the results from the profitability regression that only includes indicator for silent R&D firms and industry and year fixed effects. In this specification, the coefficient on the indicator for silent R&D firms is 0.0450, significant at the 1% level. This estimate implies that future profitability, accumulated over the next three years, is 4.5 percentage points higher for silent R&D firms. This 4.5 percentage point difference is in line with the spread in Figure 3 at the same horizon. In terms of economic significance, this estimate translates to an additional $52.6 million in operating profits. Column (2) shows the results from the profitability regression that additionally includes intangible investment and interaction of intangible investment with the indicator for silent R&D firms. The coefficient on intangible investment is 0.7358, significant at the 1% level, meaning that 1 dollar of intangible investment translates into 74 cents of three-year operating profit. The coefficient on the interaction between the indicator for silent R&D firms and intangible investment is 0.5030, significant at the 1% level. This estimate indicates that 1 dollar of intangible investment translates into additional 50 cents of three-year operating profit, to the total of 1 dollar 24 cents per dollar of intangible investment. This means that silent R&D firms have 68% higher productivity of intangible investment relative to non-silent R&D firms. The coefficient on the indicator for silent R&D firms is insignificant, meaning that the higher productivity of intangible investment explains the outperformance of silent R&D firms. In Columns (3) and (4), I repeat the tests after including control variables. In Column (3), the coefficient on the indicator for silent R&D firms is 0.0274, significant at the 1% level. This estimate implies that future profitability, accumulated over the next three years, is almost 3 percentage points higher for silent R&D firms. In Column (4), the coefficient on the interaction term between indicator for silent R&D firms and intangible investment is 0.2449, significant at the 1% level. This estimate implies that silent R&D firms have higher productivity of intangible investment relative to non-silent R&D firms. Finally, the coefficient on the indicator for silent R&D firms is insignificant, meaning that higher productivity of intangible investment explains the outperformance of silent R&D firms. In terms of control variables, the regressions in Columns (3) and (4) show that future profitability is increasing in current profitability, size, and Tobin's Q, and weakly decreasing in leverage.

In summary, the results in this section show that silent R&D firms have higher future operating profitability, by about 3 to 4.5 percentage points accumulated over the next three years. Further, this outperformance of silent R&D firms is explained by the higher productivity of the intangible investment. This evidence aligns well with the intuition that silence enshrouds better ideas.

4.2.2. Performance decomposition

My primary performance metric is future accumulated profitability. In this section, I decompose future profitability into sales growth and average margin as follows:

$$Profitability_{it+1,t+H} = \frac{\sum_{h=1}^{H}(sales_{it+h})}{K_{it-1}} \times \frac{\sum_{h=1}^{H}(OP_{it+h} + R\&D_{it+h}^{am} + \lambda SG\&A_{it+h}^{am})}{\sum_{h=1}^{H}(sales_{it+h})} = Sales_{it+1,t+H} \times Margin_{it+1,t+H} \quad (5)$$

Where $Sales_{it+1,t+H}$ are sales accumulated over the next H years divided by the beginning-of-period capital at t=0, and $Margin_{it+1,t+H}$ is average margin over the next H years calculated as the sum of operating profits adjusted for R&D and fraction of SG&A after amortization divided by the sum of sales over the same period.

In Figure 4, I present the future profitability of Silent R&D firms decomposed into sales growth (Panel A) and operating margins (Panel B). Figure 4 Panel A illustrates $Sales$ in the current year ($t = 0$) and then cumulative $Sales$ accumulated over the next $H = 1, \dots, 5$ years, all relative to beginning-of-period adjusted net operating assets at t=0. Thus, this figure represents an average pattern of $Sales$ growth over the next five years. I adjust the cumulative $Sales$ for respective industry-year means. Figure 4 Panel A shows stronger growth of silent R&D firms: the industry-year-adjusted cumulative $Sales$ of silent R&D firms is increasing from less than 25% of capital in the current period to about 200% of capital over the five-years-out horizon. In contrast, non-silent R&D firms underperform the industry-year benchmarks: the industry-year-adjusted cumulative $Sales$ of R&D-reporting firms is decreasing from around 0% in the current period to less than -25% of capital over the five-periods-out horizon. Figure 4 Panel B illustrates $Margin$ in the current year (t=0) and then $Margin$ averaged over the next $H = 1, \dots, 5$ years. Thus, this figure represents an average pattern of $Margin$ evolution over the next five periods. I adjust the average $Margin$ for respective industry-year means. Figure 4 Panel B shows higher margins of silent R&D firms: the industry-year-adjusted average $Margin$ of silent R&D firms is over 4% in the initial year and mean reverts to about 2.5% above the annual industry benchmark. The decline is consistent with mean reversion in margins (Nissim and Penman 2001). In contrast, R&D-reporting firms underperform the annual industry benchmarks: the industry-year-adjusted average $Margin$ of R&D-reporting firms is almost -1% in the initial year and then mean reverts towards 0% over the five-years-out horizon. Despite mean-reversion in the earlier years, there is persisting spread in $Margin$ between silent and R&D-reporting firms. Taken together, the visual evidence in Figure 4 shows that the outperformance of Silent R&D is a combination of stronger sales growth and higher margins.

In Table 4, I report the regression results for profitability components. Columns (1) and (2) show results for the regressions with future accumulated $Sales$ as a dependent variable. In Column (1), the coefficient on the indicator for silent R&D firms is 0.2003, significant at the 1% level. This estimate implies that future $Sales$, accumulated over the next three years and scaled by beginning-of-period capital, is 20 percentage points higher for silent R&D firms. On average, this estimate translates to an additional $234.2 million in sales. In Column (2), the coefficient on the interaction term is 1.6302, significant at the 1%. This estimate implies that additional dollar of intangible investment results in 1.63 dollars more for silent R&D firms; that is, intangible investment is more productive, roughly twice as productive as non-silent R&D firms. In Column (3), the coefficient on the indicator for silent R&D firms is 0.0320, significant at the 1% level. This estimate implies that future $Margin$, averaged over the next three years, is almost 4 percentage points higher for silent R&D firms. In Column (4), the coefficient on the interaction term is 0.1820, significant at the 1% level. This estimate implies that a 1 percentage point change in investment is associated 18 basis point higher margin for silent R&D firms. Also, the coefficient on the silent R&D indicator is insignificant in specifications that include an interaction term, meaning that higher productivity of the intangible investment explains the outperformance of silent R&D firms. Taken together, the regression results in Table 4 show that outperformance of Silent R&D is a combination of stronger sales growth and higher margins.

In summary, the results in this section show that silent R&D firms have higher future sales, by about 20 percentage points accumulated over the next three years, and also higher margins, by almost 4 percentage points averaged over the next three years. The two profitability drivers, sales growth and operating margins, contribute jointly to the outperformance of the silent R&D firms. This evidence aligns well with the intuition that silence enshrouds better ideas.

4.2.3. Performance benchmarks

In this section, I evaluate the performance of silent R&D firms relative to industry-matched sample, propensity score matched sample, and entropy-balanced sample. I show that the incremental profitability of silent R&D firms is consistent at around 2.5 to 3 percentage points across all three performance benchmarks.

In Table 5, I report profitability regressions using alternative samples. In Columns (1) and (2), I focus on the industry-matched sample of firms from the R&D-reporting industries, that is, R&D-intensive industries where the majority of firms report R&D. In Column (1), the coefficient on the indicator for silent R&D firms is 0.0260, significant at the 1% level, meaning that future profitability is about 2.5 percentage points higher for silent R&D firms relative to other firms in R&D-reporting industries. In Column (2), the coefficient on the interaction term is 0.3120, significant at the 1% level, which implies that incremental productivity in silent R&D firms is 31 cents from every dollar of intangible investment. In Columns (3) and (4), I focus on comparison firms matched one-to-one using the propensity score ("p-score") of Rosenbaum and Rubin (1983). I estimate the p-score using intangible investment, profitability, size, age, leverage, and Q as determinants of silence. I also add squared terms (Hirano et al. 2003), as well as industry and year fixed effects. The model explains 30% of the variation in silence, based on Nagelkerke's (1991) Pseudo-R^2. I still use the variables from the p-score regressions in the profitability regressions, which is doubly-robust estimation (Ho et al. 2007). In Column (3), the coefficient on the indicator for silent R&D firms is 0.0239, significant at the 1% level, meaning that future profitability is almost 3 percentage points higher for silent R&D firms relative to comparable firms matched using p-score. In Column (4), the coefficient on the interaction term is 0.2584, significant at the 1% level, which implies that incremental productivity in silent R&D firms is 26 cents from every dollar of intangible investment. In Columns (5) and (6), I use entropy balancing method of Hainmueller (2012) to reweight control observations. The weights are estimated using cross-sectional determinants of silence, their squared terms, and industry and year fixed effects as matching variables.[7] This method improves the covariate balance between silent R&D and control firms with respect to the first and second moments. In Column (5), the coefficient on the indicator for silent R&D firms is 0.0239, significant at the 1% level, meaning that future profitability is almost 2.5 percentage points higher for silent R&D firms relative to comparable firms based on entropy balancing. In Column (6), the coefficient on the interaction term is 0.2689, significant at the 1% level, which implies that incremental productivity in silent R&D firms is 27 cents from every dollar of intangible investment. The coefficient on the indicator for silent R&D firms is insignificant in specifications that include the interaction term, meaning that higher productivity of intangible investment explains the outperformance of silent R&D firms. Finally, the estimates of the incremental profitability and incremental productivity of silent R&D firms are comparable, in terms of economic magnitude, between the matching methods and are similar to the baseline estimates based on the full sample of firms.

In summary, the results in Table 5 show that silent R&D firms have higher future profitability and higher intangible productivity relative to other firms in R&D-reporting industries or comparable firms matched using the p-score or entropy balancing methods. The silent R&D firms outperform these alternative performance benchmarks by about 2.5 to 3 percentage points, and this incremental profitability is explained by higher intangible productivity.

4.3. Measurement

4.3.1. SG&A reclassification thresholds

In this section, I evaluate alternative screening criteria for silent R&D firms based on the level of *abnormal* SG&A. Because silent R&D firms do not to disclose R&D as a separate

[7] To estimate the weights, I rely on the *ebal* package developed for R by Jens Hainmueller.

line item but instead pool it with other expenses, these firms will likely have higher levels of SG&A relative to comparable non-silent R&D firms. I show silent R&D firms defined more narrowly based on the level of abnormal SG&A have higher future profitability and that the economic magnitude of this higher future profitability increases with the SG&A reclassification threshold.

In Table 6, I report profitability regressions using alternative definitions of silent R&D firms based on the level of abnormal SG&A. I define abnormal SG&A as the difference between reported SG&A and expected SG&A, where expected SG&A is the median SG&A of the R&D-reporting firms in the same year, industry, and market capitalization quintile. In Columns (1) and (2), I define silent R&D firms as firms with missing R&D, operating in R&D-reporting industry, and with abnormal SG&A greater than 0. Because of the SG&A requirement, these firms are a subset of previously identified silent R&D firms and constitute 7.0% of the full sample. In Column (1), the coefficient on the indicator for silent R&D firms is 0.0330, significant at the 1% level, meaning that future profitability is over 3 percentage points higher for silent R&D firms. In Column (2), the coefficient on the interaction term is 0.2616, significant at the 1% level, meaning that incremental productivity in silent R&D firms is 26 cents from every dollar of intangible investment. In Columns (3) and (4), I define silent R&D firms as firms with missing R&D, operating in R&D-reporting industry, and with abnormal SG&A greater than 5% of beginning-of-period capital. Because of the SG&A materiality requirement, these firms are a subset of previously identified silent R&D firms and constitute 5.2% of the full sample. In Column (1), the coefficient on the indicator for silent R&D firms is 0.0353, significant at the 1% level, meaning that future profitability is 3.5 percentage points higher for silent R&D firms. In Column (4), the coefficient on the interaction term is 0.3040, significant at the 1% level, meaning that incremental productivity in silent R&D firms is 30 cents from every dollar of intangible investment. In Columns (5) and (6), I define silent R&D firms as firms with missing R&D, operating in R&D-reporting industry, and with abnormal SG&A greater than 10% of beginning-of-period capital. Because of the higher SG&A materiality requirement, these firms are a subset of previously identified silent R&D firms and constitute 3.8% of the full sample. In Column (5), the coefficient on the indicator for silent R&D firms is 0.0459, significant at the 1% level, meaning that future profitability is over 4.5 percentage points higher for silent R&D firms. In Column (6), the coefficient on the interaction term is 0.3285, significant at the 1% level, meaning that incremental productivity in silent R&D firms is 33 cents from every dollar of intangible investment. The coefficient on the indicator for silent R&D firms is insignificant in specifications that include the interaction term, meaning that higher productivity of intangible investment explains the outperformance of silent R&D firms. Finally, the estimates of the incremental profitability and incremental productivity of silent R&D firms increase, in terms of economic magnitude, with the SG&A reclassification threshold. This finding implies that the outperformance of silent R&D firms is highest for the subsample of firms that are more likely to be pooling R&D with SG&A.

In summary, the results in Table 6 show that the outperformance of silent R&D firms is driven by the firms that are more likely to be pooling R&D with SG&A. The future profitability is highest for the relatively narrow definitions of silent R&D firms that require material levels of abnormal SG&A. This evidence is also consistent with the predictions of the Jiang et al. (2021) model wherein firms with higher perceived investment productivity prefer pooling of investment with operating expenses in presence of information asymmetry about uncertain future benefits to new investment.

4.3.2. Intangible capital measurement

Following prior work (e.g., Hulten and Hao 2008, Eisfeldt and Papanikolaou 2014, Peters and Taylor 2017), I assume that 30% of as-reported SG&A expense is capitalized as off-balance sheet organizational capital. I also assume that 100% of as-reported R&D is capitalized as off-balance sheet knowledge capital. In a recent study, Ewens et al. (2020) provide industry-specific estimates of the fraction of SG&A expense that should be capitalized as the organizational capital. Similarly, Iqbal et al. (2021) provide industry-specific estimates of the fraction of R&D expense that should be capitalized as the knowledge capital. In this section, I compare the results under fixed and industry-varying estimates of the investment portion of R&D and SG&A. I show consistent evidence of the outperformance of the silent R&D firms across alternative capitalization schemes based on these assumptions.

In Table 7, I report profitability regressions using alternative capitalization schemes. In Columns (1) and (2), I present my baseline profitability regressions using Peters and Taylor (2017) data that assumes that 100% of R&D is capitalized as knowledge capital and fixed $\lambda = 30\%$ of SG&A is capitalized as organizational capital. In Columns (3) and (4), I capitalize 100% of R&D investment and but use industry-varying values of λ to estimate levels of SG&A investment and organizational capital, using data from Ewens et al. (2020). When aggregated in accordance with GICS industry classification in my sample, the industry-specific rates vary from 19% in Food and Staples Retailing Industry to 47% in Pharmaceuticals, Biotechnology & Life Sciences Industry. The average lambda is 29%, which is close to 30% used by Peters and Taylor (2017). In Column (3), the coefficient on the indicator for silent R&D firms is 0.0314, significant at the 1% level, and comparable to the estimate of 0.0274 in Column (1). In Column (4), the coefficient on the interaction term is 0.2793, significant at the 1% level, meaning that silent R&D firms have higher intangible productivity. In Columns (5) and (6), I additionally use the industry-specific assumptions about the fraction of R&D expense that should be capitalized as knowledge capital and R&D depreciation rates from Iqbal et al. (2021). When aggregated in accordance with GICS industry classification in my sample, the industry-specific R&D investment fractions vary from 66% in Software & Services industry to 90% in Pharmaceuticals, Biotechnology & Life Sciences Industry. The average R&D investment fraction is 77%, which is less than 100% used in prior research. In Column (5), the coefficient on the indicator for silent R&D firms is 0.0275, significant at the 1% level, and comparable to the corresponding estimates in Columns (1) and (3). In Column (6), the coefficient on the interaction term is 0.1493, significant at the 5% level, meaning that silent R&D firms have higher intangible productivity. The coefficient on the indicator for silent R&D firms is insignificant in specifications that include the interaction term, meaning that higher productivity of intangible investment drives the incremental future profitability of silent R&D firms.

In summary, the results in Table 7 show that silent R&D firms have higher productivity and higher intangible productivity under both fixed and industry-specific assumptions about R&D and SG&A investment. The incremental profitability of silent R&D is consistent at around 3 percentage points, and this outperformance is explained by higher intangible productivity.

4.3.3. Total investment productivity

In this section, I focus on the total investment which is a sum of physical and intangible investment components and I show that higher investment productivity of silent R&D firms is driven primarily by the intangible component, although physical investment is also more productive in the silent R&D firms.

In Table 8, I report profitability regressions using alternative investment rates. In Columns (1) and (2), I examine the productivity of total investment that includes physical and intangible investment, where physical investment is balance sheet change in property, plant, and equipment (PP&E) plus depreciation divided by the beginning-of-period capital. The intangible investment component is defined as described in section 3.2. In Column (1), the coefficient on the indicator for silent R&D firms is 0.0268, significant at the 1% level. This estimate implies that future profitability, accumulated over the next three years, is almost 3 percentage points higher for silent R&D firms. In Column (2), the coefficient on the interaction term is 0.1802, significant at the 1% level. This estimate implies that incremental productivity in silent R&D firms is 18 cents from every dollar of total investment. In Columns (3) and (4), I separately examine the physical investment component. The coefficient on the interaction term is 0.1827, significant at 1% level. This estimate implies that physical investment is incrementally more productive in silent R&D firms. This finding is consistent with the fact that physical investment usually includes research outlays related to R&D investment (Schankerman 1981). However, the coefficient on the indicator for silent R&D firms is 0.121, significant at 5% level, which means that the differences in physical investment productivity are not sufficient to fully explain the incremental profitability of silent R&D firms. In Columns (5) and (6) I report my baseline results for the intangible investment component. I find that higher productivity of the intangible investment explains the incremental productivity of silent R&D firms, which means that the outperformance of silent R&D firms is driven primarily by the higher productivity of their intangible capital.[8]

In summary, the results in Table 8 I show that silent R&D firms have higher total investment productivity, including physical and intangible components. I show that higher profitability and higher investment productivity of silent R&D firms is driven primarily by intangible investment, although physical investment is also more productive in silent R&D firms.

---

[8] In an additional analysis, I decompose the intangible investment further into two components: the balance sheet intangible investment and off-balance sheet intangible investment (R&D and SG&A investment). In this test, I show that higher intangible productivity of silent R&D firms is driven primarily by the off-balance sheet component, although balance sheet intangible investment is also more productive in the silent R&D firms.

4.4. Relation to prior research

4.4.1. Silent R&D and 10-K secrecy

Prior literature has relied on the textual analysis to measure secrecy at the firm level. However, truly secretive firms will likely avoid any additional disclosures that might betray their secrets for the same reasons they avoid providing R&D disclosures. Therefore, there will be many silent R&D firms without additional disclosures about secrets or innovation in general. In this section, I examine the overlap between silent R&D firms and secrecy disclosure firms. Following Glaeser (2018), I use mentions of trade secrecy in annual 10-K filings to identify secrecy disclosure firms.

Table 9 explores variation across partitions based on 10-K secrecy. In Columns (1) and (2), I test the performance of silent R&D firms within the sample of firms that do not mention trade secrecy in their 10-Ks. In Column (1), the coefficient on the indicator for silent R&D firms is 0.0292, significant at the 1% level. This estimate implies that future profitability is almost 3 percentage points higher for silent R&D firms. In Column (2), the coefficient on the interaction term is 0.2696, significant at the 1% level, meaning that incremental productivity in silent R&D firms is 27 cents from every dollar of intangible investment. In Columns (3) and (4), I test the performance of silent R&D firms within the sample of 10-K secrecy firms. In Column (3), the coefficient on silent R&D indicator is 0.0331, significant at the 1%. This result is interesting because it means that silence is associated with higher future performance even among firms that we know rely on trade secrets based on their disclosure. In Column (4), the coefficient on the interaction term is 0.2234, significant at the 5% level, meaning that incremental productivity in silent R&D firms is 22 cents from every dollar of intangible investment. The coefficient on the indicator for silent R&D firms is insignificant in specifications that include the interaction term, meaning that higher productivity of intangible investment explains the outperformance of silent R&D firms. Finally, the estimated incremental productivity of silent R&D firms is comparable between the two partitions, meaning that the results are mostly orthogonal to the effects of 10-K secrecy. Also, the frequency of silent R&D firms is lower in the sample of 10-K secrecy firms (9.8%) than it is in the sample of firms without 10-K secrecy (13.4%), meaning that silent R&D firms are indeed less likely to mention trade secrets in 10-K.

In summary, the results Table 9 show that silent R&D firms are different from firms that disclose reliance on trade secrecy in their 10-K filings. Accordingly, the outperformance of silent R&D firms is not driven by 10-K secrecy firms. Instead, I find that silent R&D firms have higher future profitability and higher productivity of the intangible investment among firms with and without 10-K secrecy mentions.

4.4.2. Silent R&D and patenting activity

Secrecy and patents are substitutes due to tradeoffs inherent in disclosure decisions. In addition, secrecy is often available in cases when patenting is not. For example, secrecy can be more readily used to protect process innovation or work-in-progress, it can be employed for an indefinite period of time, and it does not involve filing costs (see Hall et al. 2014). Given the substitution between secrecy and patenting and the fact that secrecy can be used more broadly, I expect my results to hold more strongly for non-patenting firms. I look at patenting as a disclosure decision, much like R&D reporting. In this sense, silent R&D firms will choose nondisclosure and allow the value of their innovation to be revealed over time in the form of higher profitability. In contrast, Gleaser et al. (2020) find that firms with short-term horizons patent more in order to demonstrate the value of their R&D to the market.

Table 10 explores variation across partitions based on patenting activity. In Columns (1) and (2), I present the results for the subsample of non-patenting firms. This subsample includes the majority of firms. In Column (1), the coefficient on the indicator for silent R&D firms is 0.0263, significant at the 1% level. This estimate implies that future profitability is almost 3 percentage points higher for silent R&D firms. In Column (2), the coefficient on the interaction term is 0.2236, significant at the 1% level, meaning that incremental productivity in silent R&D firms is 23 cents from every dollar of intangible investment. The coefficient on the indicator for silent R&D firms is insignificant in this specification, meaning that higher productivity of intangible investment explains the outperformance of silent R&D firms. In Columns (3) and (4), I test the performance of silent R&D firms within the sample of patenting firms. This sample includes in particular the "pseudo R&D" firms of Koh and Reeb (2015), which are missing R&D firms with patenting activity. I find no evidence of outperformance of silent R&D firms in the high patenting subsample, because patenting mostly rules out secrecy. Finally, the frequency of silent R&D firms is much higher in the sample of non-patenting firms (15.9%) than it is in the sample of patenting firms (5.7%), meaning that silent R&D firms are indeed less likely to patent.

In summary, the results of the cross-sectional test based on patenting show silent R&D firms patent less and instead allow the value of their innovation to be revealed over time in the form of higher profitability. I find that non-patenting firms drive outperformance of silent R&D firms and that silent R&D firms are different from pseudo R&D firms identified in prior research.

4.4.3. Silent R&D and disclosure quality

The lack of R&D disclosure might reflect poor disclosure quality rather than a firm's commitment to stay silent. Ali et al. (2014) show that the disclosure quality is generally lower in more competitive, concentrated industries because of the proprietary cost. In this section, I document that silent R&D is not merely a reflection of poor disclosure.

For this test, I use the new measure of disclosure quality – disaggregation quality (DQ), introduced by Chen et al. (2015). DQ score is the weighted proportion of missing income statements and balance sheet items in company filings, and it varies between 0 (no disclosure) to 1 (complete disclosure). Any missing items (including, but not limited to, missing R&D and SG&A items) suggest that the firm's financial statements are not detailed, assuming that the data collection process is not systematically biased. Chen et al. (2015) find that DQ accurately measures disclosure quality.

Table 11 explores variation across partitions based on DQ score. I separate firms into the partitions of low and high DQ scores based on industry-year median breakpoints. In

Columns (1) and (2), I test the performance of silent R&D firms within the sample of low DQ firms. In Column (1), the coefficient on the indicator for silent R&D firms is 0.0314, significant at the 1% level. This estimate implies that future profitability is about 3 percentage points higher for silent R&D firms in the low DQ subsample. In Column (2), the coefficient on the interaction term is 0.2275, significant at the 1% level, meaning that silent R&D firms are more productive. In Columns (3) and (4), I test the performance of silent R&D firms within the sample of high DQ firms. In Column (3), the coefficient on silent R&D indicator is 0.0248, significant at the 1% level. This estimate implies that future profitability is about 2.5 percentage points higher for silent R&D firms in the high DQ subsample. In Column (4), the coefficient on the interaction term is 0.2843, significant at the 1% level, meaning that silent R&D firms are more productive. The coefficient on the indicator for silent R&D firms is insignificant in specifications that include the interaction term, meaning that higher productivity of intangible investment explains the outperformance of silent R&D firms. Finally, the frequency of silent R&D firms is higher in the sample of low DQ firms (14.8%) than it is in the sample of high DQ firms (11.0%), consistent with the fact that missing R&D contributes to the low DQ score. Overall, however, the frequency of silent R&D firms is significant in both DQ partitions.[9]

In summary, the results in Table 11 show that R&D silence is not reflective of poor disclosure. I find that silent R&D firms have higher future profitability and higher productivity of intangible investment across disclosure quality partitions. Because the proprietary cost of disclosure is especially high for R&D, firms can choose not to disclose R&D without sacrificing overall disclosure quality.

4.5. Market-based evidence of cost pooling in silent R&D firms

I further examine the investment of silent R&D firms using the neoclassical theory of investment to observe the behavior of each investment component. Since Hayashi (1982), investment increases linearly in Tobin's Q, which proxies for unobservable marginal Q. In this model, the investment-Q sensitivity was interpreted as a measure of investment efficiency or as an inverse measure of capital market imperfections (Hubbard 1998).

Following Peters and Taylor (2017), I separately model each investment component as a function of Q. I begin with total investment, which includes physical and intangible investment. I measure physical investment as the change in net property, plant, and equipment (PP&E) plus depreciation. As before, the intangible investment has three components: the investment in externally acquired balance-sheet intangibles, R&D investment, and the SG&A investment, which is a fraction of SG&A expense. I scale all investment measures by the beginning-of-period capital. All investment regressions control

---

[9] In the additional analysis, I decompose DQ score into its income statement and balance sheet components. The results are similar to the ones using a combined score in that the silent R&D firms have higher future profitability and higher productivity of intangible investment across partitions formed on either the income-statement DQ score (DQ^{IS}) or balance-sheet DQ score (DQ^{BS}). The frequency of silent R&D firms is significant across all partitions. It is also higher for low DQ^{IS} subsample (15.0%) that for high DQ^{IS} subsample (10.7%), given that missing R&D is a component of the DQ^{IS}.

for cash flow. Beginning with Fazzari et al. (1988), the literature has recognized that investment will vary with internally generated funds. In line with Peters and Taylor (2017), I measure cash flow, CF_t, as income before extraordinary items plus depreciation and amortization plus after-tax R&D investment plus after-tax SG&A investment scaled by the beginning-of-period capital. The results are robust to using a measure of operating cash flow based on the statement of cash flows data, but the sample size is shorter due to the limited availability of statement of cash flow data. Finally, all investment models include firm and year fixed effects to control firm- and year-specific factors.

Table 12 reports regressions of total investment and its components on beginning-of-period Q and cash flow. Starting with total investment in Column (1), I show that total investment is weakly smaller in silent R&D firms. The overall investment-Q sensitivity is 0.0312, significant at the 1% level. The incremental investment-Q sensitivity of the silent R&D firms is 0.0041, significant at the 10% level. In Columns (2-5) I examine components of total investment. Column (2) shows that the level of physical investment and the investment-Q sensitivity are similar between silent R&D and non-silent R&D firms, suggesting that the differences will be driven by intangible components. Column (3) shows that the investment in balance-sheet intangibles is on average 0.0059 lower for silent R&D firms. The incremental investment-Q sensitivity of silent R&D firms is 0.0066, significant at the 1% level. Column (4) shows that the R&D investment is on average 0.0121 lower for silent R&D firms since they do not report R&D. The incremental investment-Q sensitivity of silent R&D firms is -0.0061, significant at the 1% level. Given the baseline investment Q-sensitivity of 0.0052, this result suggests that the reported R&D investment is virtually insensitive to Q, which is consistent with the absence of reported R&D regardless of Q. Finally, Column (5) shows that the investment in SG&A is on average 0.0090 higher for silent R&D firms, which is consistent with the pooling of R&D investments with SG&A expense. The incremental investment-Q sensitivity of silent R&D firms is 0.0033, significant at the 1% level. Given the baseline investment Q-sensitivity of 0.0034, this result suggests that the SG&A investment is twice as sensitive to Q in silent R&D firms as it is in non-silent R&D firms.

In summary, the results in Table 12 show that: (a) the reported R&D investment in silent R&D is absent and thus insensitive to Q, (b) silent R&D firms have higher SG&A investment after controlling for Q and cash flow, and (c) the SG&A investment in silent R&D firms is twice as responsive to Q as it is in non-silent R&D firms. Overall, these results are consistent with the pooling of R&D investment with SG&A expense in silent R&D firms.

In an additional analysis, I also check whether the reduction in R&D disclosure is associated with substitution away from internally organized research projects into M&A or joint ventures (Robinson 2008). I find that silence is associated with a statistically significant decrease in the likelihood of joined venture or R&D agreements. These results imply that silent firms will be less likely to participate in knowledge-sharing alliances. I also find that silent R&D firms are more likely to engage in M&A, possibly with an intention to obtain synergies from combining innovative capabilities (Bena and Li, 2014) or to access human capital (Chen et al. 2020). Accordingly, in the profitability regressions using the dollar value of acquisition deals reported in SDC data as a measure of M&A investment, I find that productivity of M&A investment is higher in the silent R&D firms.

4.6. Estimating SG&A reclassification rate for silent R&D firms

If silent R&D reclassify their R&D investment as part of the SG&A expense, the intangible investment in organizational capital can be a higher fraction of as-reported SG&A expense in silent R&D firms than it is in non-silent R&D firms.[10] In this section, I search for the SG&A reclassification rate that would explain the profitability difference between silent and non-silent R&D firms. I define the SG&A reclassification rate, denoted Δ, as the portion of SG&A expense that would otherwise be reported as R&D investment in silent R&D firms. The reclassified amount is incremental to SG&A investment in organizational capital, denoted λ. Accordingly, the total fraction of SG&A expense that constitutes intangible investment is $(\lambda + \Delta)$ for silent R&D firms and λ for other firms.

In Figure 5, I show how different assumptions about reclassification rate Δ change the inference about the performance of silent R&D firms. In Panel A, I report the estimated coefficient on the indicator for silent R&D firms from the profitability regression that controls for intangible investment, current profitability, firm size and age, leverage, and beginning-of-period Q, using a fixed fraction of SG&A investment ($\lambda = 30\%$). Assuming $\Delta = 0$, the coefficient on $I(Silent\ R\&D_{it})$ is equal 0.0274 and coincides exactly with the coefficient in Table 7, Column (1). As Δ increases, the incremental profitability of silent R&D firms decreases. Mechanically, higher SG&A investment implies that profitability will be lower on per dollar of capital basis, because in this simulation, the company increases its capital without any change in sales or gross profits. The shaded area separates the values of Δ at which the incremental profitability of silent R&D firms is statistically significant at the 10% level. When $\Delta = 41\%$, silent R&D firms are no more profitable, in statistical terms, than non-silent R&D firms. Equivalently, the two types of firms will be comparable if it was the case that an additional 41% of SG&A expense in silent R&D firms was a reclassified R&D investment. Given that the average level of SG&A investment for silent R&D companies in my sample is $275.6 million, this translates to the average level of reclassified R&D investment at $113.0 million annually per silent R&D company. This level of the reclassified R&D explains away the profitability difference between the two types of firms. However, even absent any differences in future profitability, the profitability drivers can differ between the two types of companies. With higher intangible spending, the intangible investment is still a key profitability driver for silent R&D firms.

In Panel B, I repeat the reclassification rate analysis using industry-specific capitalization assumptions about the SG&A and R&D investment, following Ewens et al. (2020) and Iqbal et al. (2021). Using industry-specific assumptions about SG&A and R&D

---

[10] The first consequence of the reclassification will be the higher level of SG&A investment. I find evidence consistent with this observation in Table 8, where I show that silent R&D firms have higher SG&A investment. Here, I make stronger assumption that not only the level but also the fraction of SG&A investment (relative to SG&A expense) can be larger for silent R&D firms.

investment, I estimate industry-specific reclassification rates Δ_j for each R&D-reporting industry j. Assuming $\Delta_j = 0$ for all j, the coefficient on $I(Silent\ R\&D)$ is equal 0.0275 and coincides exactly with the coefficient in Table 7, Column (6). As Δ_j increases, the incremental profitability of silent R&D firms decreases. Figure 5 Panel B reports Δ_j values for each R&D-reporting industry j such that silent R&D firms are no more profitable, statistically at the 10% level, than non-silent R&D firms. These are the industry-specific estimates of the reclassification rates. On average, the industry-specific reclassification rate is 39%, which is close to the fixed reclassification rate estimated in Table 5 Panel A. This translates to the average level of reclassified R&D investment at $86.1 million annually per silent R&D company.

In summary, the results in Figure 5 show that my findings are largely robust to imposing incrementally higher intangible investment on silent R&D firms. Furthermore, solving for the R&D reclassification rate that explains the profitability difference between silent and non-silent R&D firms provides an initial estimate of the shadow value of the R&D investment reported as part of the SG&A expense. However, the fixed and industry-specific reclassification rates presented in Figure 5 are necessarily an imperfect proxy for the unobservable reclassification rates.

5. Conclusion

In competitive markets where ideas are getting harder to find, firms have strong incentives to keep their ideas quiet. Many innovative firms will remain silent about their R&D even if their research efforts are very productive. I find that silent R&D firms have higher future profitability and that this higher profitability is primarily due to the higher productivity of their intangible capital. In this sense, silence enshrouds better ideas.

By establishing the link between silence and intangible productivity, I contribute to the existing literature on disclosure and innovation. First, I add to the evidence in Koh and Reeb (2015) by showing that silent R&D firms have higher future profitability and are less likely to patent. Second, I show that simple screening criteria suffice to identify outperforming silent R&D firms. Specifying a complete selection model is beyond the scope of the paper and constitutes an interesting avenue for future research. Third, I show that silent R&D is different from other dimensions of secrecy identified in the prior research (e.g., Glaeser 2018). Fourth, I show that not reporting of R&D is different from having low-quality disclosure (Ali et al. 2014). Fifth, my results imply that some intangible productivity will be missing from any analysis that focuses on the reported R&D, which relates to the literature on research productivity (e.g., Bloom et al. 2020). Sixth, I show that silent R&D firms reclassify their R&D investment as SG&A expense and I provide initial estimates of the SG&A reclassification rates. This relates to the growing literature on measuring intangible capital (Peters and Taylor 2017, Ewens et al. 2020, Iqbal et al. 2021).

An interesting direction for follow-up research would be to broaden the sample of silent innovators to include companies with insufficient (as opposed to zero) R&D disclosure. This way, the sample could include the biggest innovators such as Apple or Amazon, depending on what the future research defines as sufficient investment. In my study, I only focus on the extreme cases of no R&D disclosure at all. The expanded sample could also provide a refined estimate of the portion of R&D reclassified as SG&A for firms that do not report R&D.

References

Aboody, D., & Lev, B. (1998). The Value Relevance of Intangibles: The Case of Software Capitalization. *Journal of Accounting Research*, *36*, 161-191.

Ali, A., Klasa, S., & Yeung, E. (2014). Industry Concentration and Corporate Disclosure Policy. *Journal of Accounting and Economics*, *58*(2-3), 240-264.

Anton, J. J., & Yao, D. A. (2004). Little Patents and Big Secrets: Managing Intellectual Property. *RAND Journal of Economics*, 1-22.

Arundel, A. (2001). The Relative Effectiveness of Patents and Secrecy for Appropriation. *Research Policy*, *30*(4), 611-624.

Bena, J., & Li, K. (2014). Corporate Innovations and Mergers and Acquisitions. *The Journal of Finance*, *69*(5), 1923-1960.

Beneish, M, D., Harvey, C., Tseng, A., & Vorst, P. (2020). Unpatented Innovation and Merger Synergies. *Review of Accounting Studies*, Forthcoming.

Bhattacharya, S., & Guriev, S. (2006). Patents vs. Trade Secrets: Knowledge Licensing and Spillover. *Journal of the European Economic Association*, *4*(6), 1112-1147.

Bhojraj, S., Lee, C. M., & Oler, D. K. (2003). What's My Line? A Comparison of Industry Classification Schemes for Capital Market Research. *Journal of Accounting Research*, *41*(5), 745-774.

Bloom, N., Jones, C. I., Van Reenen, J., & Webb, M. (2020). Are Ideas Getting Harder to Find?. *American Economic Review*, *110*(4), 1104-44.

Botosan, C. A. (1997). Disclosure Level and the Cost of Equity Capital. *Accounting Review*, 323-349.

Chan, L. K., Lakonishok, J., & Sougiannis, T. (2001). The Stock Market Valuation of Research and Development Expenditures. *The Journal of Finance*, *56*(6), 2431-2456.

Chen, D., Gao, H., & Ma, Y. (2020). Human Capital-Driven Acquisition: Evidence from the Inevitable Disclosure Doctrine. *Management Science*.

Chen, S., Miao, B., & Shevlin, T. (2015). A New Measure of Disclosure Quality: The Level of Disaggregation of Accounting Data in Annual Reports. *Journal of Accounting Research*, *53*(5), 1017-1054.

Cohen, W. M., Nelson, R. R., & Walsh, J. P. (2000). *Protecting Their Intellectual Assets: Appropriability Conditions and Why US Manufacturing Firms Patent (Or Not)* (No. W7552). National Bureau of Economic Research.

Corrado, C. A., & Hulten, C. R. (2010). How do you Measure a "Technological Revolution"?. *American Economic Review*, *100*(2), 99-104.

Corrado, C., Hulten, C., & Sichel, D. (2005). Measuring Capital and Technology: An Expanded Framework. In *Measuring Capital in the New Economy* (pp. 11-46). University Of Chicago Press.

Corrado, C., Hulten, C., & Sichel, D. (2009). Intangible Capital and US Economic Growth. *Review of Income and Wealth*, *55*(3), 661-685.

Curtis, A., Mcvay, S., & Toynbee, S. (2020). The Changing Implications of Research and Development Expenditures for Future Profitability. *Review of Accounting Studies*, 1-33.

Diamond, D. W., & Verrecchia, R. E. (1991). Disclosure, Liquidity, and the Cost of Capital. *The Journal of Finance*, *46*(4), 1325-1359.

Dye, R. A., & Sridhar, S. S. (1995). Industry-Wide Disclosure Dynamics. *Journal of Accounting Research*, *33*(1), 157-174.

Eisfeldt, A. L., & Papanikolaou, D. (2014). The Value and Ownership of Intangible Capital. *American Economic Review*, *104*(5), 189-94.

Ewens, M., Peters, R. H., & Wang, S. (2020). *Measuring Intangible Capital with Market Prices* (No. W25960). National Bureau of Economic Research.

Fama, E. F., & French, K. R. (1997). Industry Costs of Equity. *Journal of Financial Economics*, *43*(2), 153-193.

Fama, E. F., & French, K. R. (2000). Forecasting Profitability and Earnings. *The Journal of Business*, *73*(2), 161-175.

Fazzari, S., Hubbard, R. G., & Petersen, B. C. (1987). Financing Constraints and Corporate Investment.

Glaeser, S. (2018). The Effects of Proprietary Information on Corporate Disclosure and Transparency: Evidence From Trade Secrets. *Journal of Accounting and Economics*, *66*(1), 163-193.

Glaeser, S., Michels, J., & Verrecchia, R. E. (2020). Discretionary Disclosure and Manager Horizon: Evidence from Patenting. *Review of Accounting Studies*, *25*(2), 597-635.

Graham, S. J. H. (2004). Hiding in the Patent's Shadow: Firms' Uses of Secrecy to Capture Value from New Discoveries. *Georgia Institute of Technology TI: GER Working Paper Series.*

Grossman, S. J. (1981). The Informational Role of Warranties and Private Disclosure About Product Quality. *The Journal of Law and Economics*, *24*(3), 461-483.

Gu, F., Lev, B., & Zhu, C. (2021). All Losses are not Alike: Real Versus Accounting-Driven Reported Losses. *Available at SSRN 3847359*.

Hainmueller, J. (2012). Entropy Balancing for Causal Effects: A Multivariate Reweighting Method to Produce Balanced Samples in Observational Studies. *Political Analysis*, *20*(1), 25-46.

Hall, B., Helmers, C., Rogers, M., & Sena, V. (2014). The Choice Between Formal and Informal Intellectual Property: A Review. *Journal of Economic Literature*, *52*(2), 375-423.

Hall, B., Mairesse, J., & Mohnen, P. (2010). *Measuring the Returns to R&D.* In Handbook of the Economics of Innovation (Vol. 2, pp. 1033-1082). North-Holland.

Harabi, N. (1995). Appropriability of Technical Innovations An Empirical Analysis. *Research Policy*, *24*(6), 981-992.

Hayashi, F. (1982). Tobin's Marginal Q and Average Q: A Neoclassical Interpretation. *Econometrica, 50*(1), 213-224.

Healy, P. M., Hutton, A. P., & Palepu, K. G. (1999). Stock Performance and Intermediation Changes Surrounding Sustained Increases in Disclosure. *Contemporary Accounting Research*, *16*(3), 485-520.

Hirano, K., Imbens, G. W., & Ridder, G. (2003). Efficient estimation of average treatment effects using the estimated propensity score. *Econometrica*, *71*(4), 1161-1189.

Ho, D. E., Imai, K., King, G., & Stuart, E. A. (2007). Matching as Nonparametric Preprocessing for Reducing Model Dependence in Parametric Causal Inference. *Political Analysis*, *15*(3), 199-236.

Horstmann, I., Macdonald, G. M., & Slivinski, A. (1985). Patents as Information Transfer Mechanisms: To Patent or (Maybe) not to Patent. *Journal Of Political Economy*, *93*(5), 837-858.

Hubbard, R. G. (1998). Capital-Market Imperfections and Investment. *Journal of Economic Literature*, *36*(1), 193-225.

Hulten, C. R., & Hao, X. (2008). *What is a Company Really Worth? Intangible Capital and the "Market to Book Value" Puzzle* (No. W14548). National Bureau of Economic Research.

Iqbal, A., Rajgopal, S., Srivastava, A., & Zhao, R. (2021). Value of Internally Generated Intangible Capital. *Available at SSRN 3917998*.

Jankowski, J. E. (2012). Business Use of Intellectual Property Protection Documented in NSF Survey. *NSF Info Brief, NSF*, 12-307.

Jiang, X., Kanodia, C., Zhang, G. (2021). *How Should Investment Expenditures be Reported when Future Benefits are Uncertain and Managers are Privately Informed?*

Khan, U., Li, B., Rajgopal, S., & Venkatachalam, M. (2018). Do the FASB's Standards Add Shareholder Value?. *The Accounting Review*, *93*(2), 209-247.

Klasa, S., Ortiz-Molina, H., Serfling, M., & Srinivasan, S. (2018). Protection of Trade Secrets and Capital Structure Decisions. *Journal Of Financial Economics*, *128*(2), 266-286.

Kogan, L., Papanikolaou, D., Seru, A., & Stoffman, N. (2017). Technological Innovation, Resource Allocation, and Growth. *The Quarterly Journal of Economics*, *132*(2), 665-712.

Koh, P. S., & Reeb, D. M. (2015). Missing R&D. *Journal of Accounting and Economics*, *60*(1), 73-94.

Koh, P. S., Reeb, D. M., & Zhao, W. (2018). CEO Confidence and Unreported R&D. *Management Science*, *64*(12), 5725-5747.

Lerner, J., & Seru, A. (2021). The Use and Misuse of Patent Data: Issues for Finance and Beyond. *The Review of Financial Studies*, Forthcoming.

Leuz, C., & Verrecchia, R. E. (2000). The Economic Consequences of Increased Disclosure. *Journal of Accounting Research*, *38*, 91-124.

Lev, B. (2001). Intangibles: Management, Measurement and Reporting, Bookings Institution Press, 2001.

Lev, B. (2019). Ending the Accounting-for-Intangibles Status Quo. *European Accounting Review*, *28*(4), 713-736.

Lev, B., & Radhakrishnan, S. (2009). The Valuation of Organization Capital. In *Measuring Capital in the New Economy* (pp. 73-110). University of Chicago Press.

Lev, B., & Sougiannis, T. (1996). The Capitalization, Amortization, and Value-Relevance Of R&D. *Journal of Accounting and Economics*, *21*(1), 107-138.

Li, W. C., & Hall, B. H. (2020). Depreciation of Business R&D Capital. *Review of Income and Wealth*, *66*(1), 161-180.

Li, Y., Lin, Y., & Zhang, L. (2018). Trade Secrets Law and Corporate Disclosure: Causal Evidence on the Proprietary Cost Hypothesis. *Journal of Accounting Research*, *56*(1), 265-308.

Milgrom, P. R. (1981). Good News and Bad News: Representation Theorems and Applications. *The Bell Journal of Economics*, *12*(2) 380-391.

Nagelkerke, N. J. (1991). A Note on a General Definition of the Coefficient of Determination. *Biometrika*, *78*(3), 691-692.

Nissim, D., & Penman, S. H. (2001). Ratio Analysis and Equity Valuation: From Research to Practice. *Review of Accounting Studies*, *6*(1), 109-154.

Oliner, S. D., & Sichel, D. E. (2000). The Resurgence of Growth in the Late 1990s: Is Information Technology the Story?. *Journal of Economic Perspectives*, *14*(4), 3-22.

Pakes, A., & Schankerman, M. (1984). The Rate of Obsolescence of Patents, Research Gestation Lags, and the Private Rate of Return to Research Resources. In *R&D, Patents, and Productivity* (pp. 73-88). University of Chicago Press.

Peters, R. H., & Taylor, L. A. (2017). Intangible Capital and the Investment-Q Relation. *Journal of Financial Economics*, *123*(2), 251-272.

Png, I. P. (2017). Law and Innovation: Evidence from State Trade Secrets Laws. *Review of Economics and Statistics*, *99*(1), 167-179.

Rajgopal, S. (2021, March 8). *Amazon Spends $42 Billion on R&D but the 10K Discusses R&D in 300 Words*. Forbes. https://www.forbes.com/sites/shivaramrajgopal/2021/03/08/amazon-spends-42-billion-on-rd-but-devotes-less-than-300-words-of-disclosure-in-its-10k

Reeb, D. M., & Zhao, W. (2020). Patents do not Measure Innovation Success. Critical Finance Review, 9(1-2), 157-199.

Robinson, D. T. (2008). Strategic Alliances and the Boundaries of the Firm. *The Review of Financial Studies*, *21*(2), 649-681.

Romer, P. M. (1990). Endogenous Technological Change. *Journal of Political Economy*, *98*(5, Part 2), S71-S102.

Rosenbaum, P. R., & Rubin, D. B. (1983). The Central Role of the Propensity Score in Observational Studies for Causal Effects. *Biometrika*, *70*(1), 41-55.

Schankerman, M. (1981). The Effects of Double-Counting and Expensing on the Measured Returns to R&D. *The Review of Economics And Statistics*, 454-458.

Scotchmer, S. (1991). Standing on the Shoulders of Giants: Cumulative Research and the Patent Law. *Journal of Economic Perspectives*, *5*(1), 29-41.

Soliman, M. T. (2004). Using Industry-Adjusted Dupont Analysis to Predict Future Profitability. *Available At SSRN 456700*.

Spence, M. (1974). Competitive and optimal responses to signals: An analysis of efficiency and distribution. *Journal of Economic Theory, 7*(3), 296-332.

Verrecchia, R. E. (1983). Discretionary Disclosure. *Journal of Accounting and Economics*, *5*, 179-194.

Wernerfelt, B. (1984). A Resource-Based View of the Firm. *Strategic Management Journal*, *5*(2), 171-180.

Appendix 1

Sample Construction

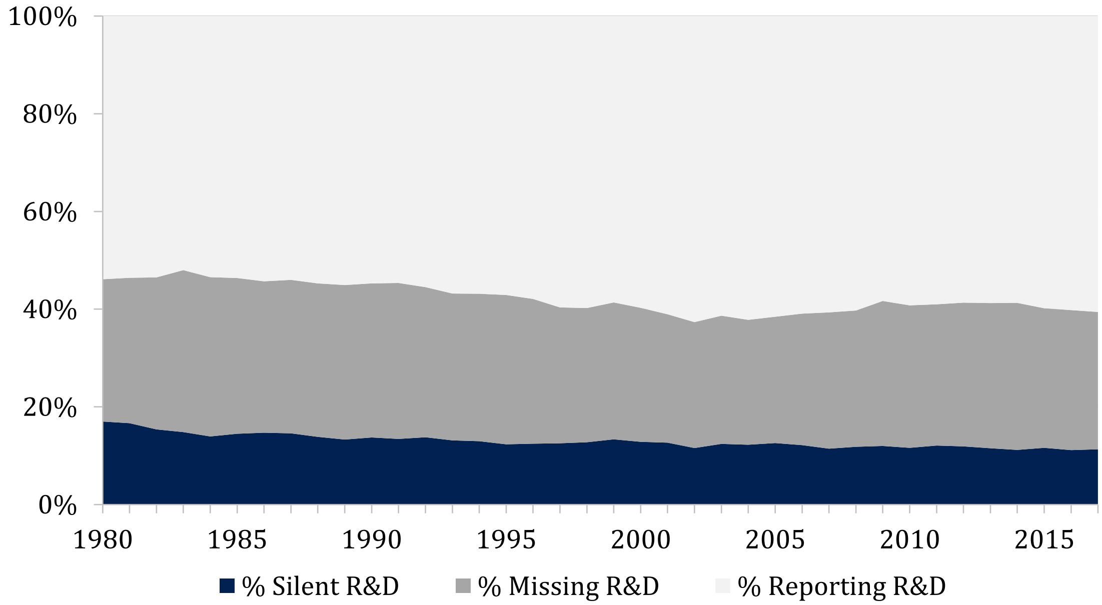
Sample Derivation Steps	N
Compustat data available between 1980 and 2020, merged with Peters and Taylor (2017) intangible capital data.	333,204
Require non-missing information about sales, profits, and assets, as well as GICS industry membership, and the information about sales and profits for up to three reporting periods out.	229,381
Require positive market and book value of equity, and net operating assets.	186,887
Exclude firms operating in the following sectors: financial (GICS sector 40), real estate (GICS sector 60) and utilities (GICS sector 55).	145,754
Final sample after trimming extreme values for key variables and removing non-missing observations.	129,810

Appendix 2

Variable Definitions

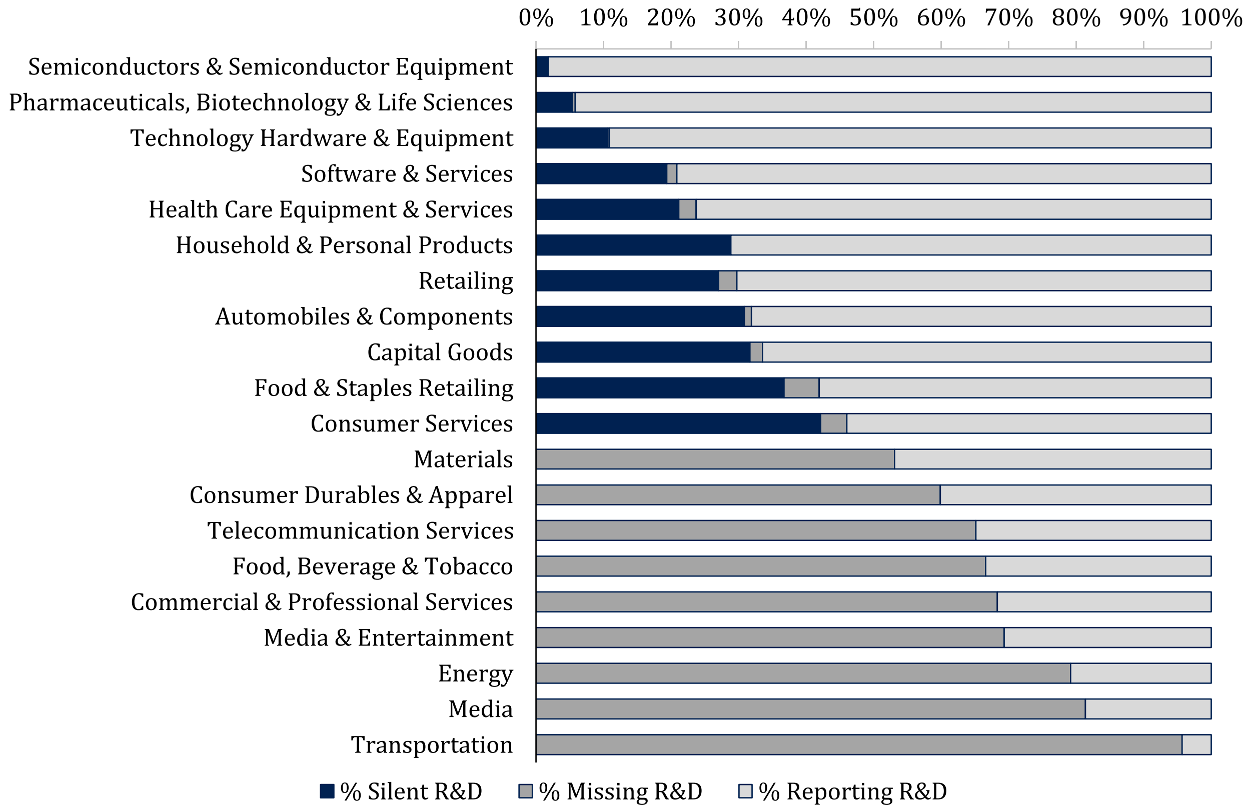
Variable	Definition
K_{it}	Firm's capital measured as the book value of equity plus book value of long-term and short-term debt (Compustat items *dlc* and *dltt*) plus book value of preferred stock (Compustat item *pstk)* plus Peters and Taylor's (2017) knowledge capital and organizational capital.
$Sales_{it}$	Sales (Compustat item *sale)* divided by beginning-of-period capital.
$Profitability_{it}$	Profitability measured as net operating income after depreciation (Compustat item *oiadp*) plus R&D expense after amortization (equal to change in knowledge capital), plus 30% of SG&A expense after amortization (equal to change in organizational capital), divided by beginning-of-period capital.
$IntInv_{it}$	Intangible investment measured as change in balance-sheet intangibles (Compustat item *intan*) plus amortization (Compustat item *am*) plus R&D investment (Compustat item *xrd*) plus 30% of SG&A expense (Compustat item *xsga* net of *xrd*) divided by beginning-of-period capital.
MV_{it}	The market value of the firm's equity, calculated as number of shares outstanding (Compustat item *csho*) times end-of-period price (Compustat item *prcc_f*).
age_{it}	The firm's age measured as years since the company's founding year.
$Leverage_{it}$	Financial leverage measured as the ratio of the book value of long-term and short-term debt and preferred stock divided by capital.
Q_{it}	Q measured as the market value of equity plus book value of long-term and short-term debt plus book value of preferred stock divided by capital.
$I(Silent\ R\&D_{it})$	Indicator variable equal to 1 if the firm is a silent R&D firm and 0 otherwise. A silent R&D firm is a firm that operates in innovative industry and chooses not to disclose R&D as a separate line item but instead pools it with other operating expenses.

Figure 1
R&D reporting over time



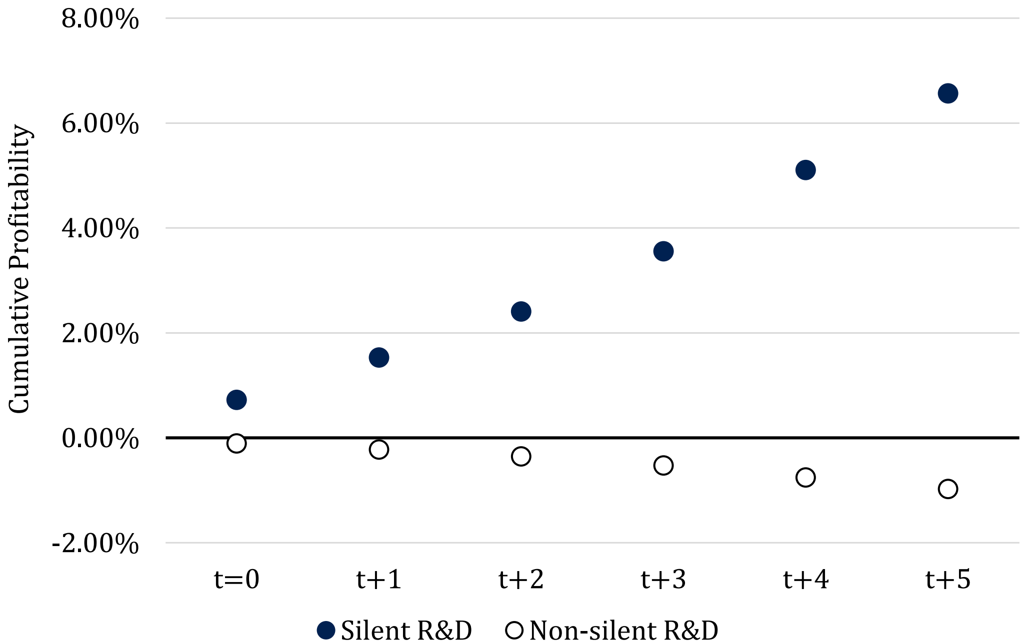
This figure presents the R&D reporting over time. Silent R&D firms are firms with missing R&D that report SG&A and operate in industries where the majority of firms report R&D. Missing R&D firms are all firms with missing R&D expense. Reporting R&D firms are firms that report R&D. The sample includes 129,810 firm-year observations between 1980 and 2017.

Figure 2
R&D reporting across industries



This figure presents R&D reporting across industries. Silent R&D firms are firms with missing R&D that report SG&A and operate in industries where the majority of firms report R&D. Missing R&D firms are all firms with missing R&D expense. Reporting R&D firms are firms that report R&D. Industry classification is based on GICS industry group membership. The sample includes 129,810 firm-year observations between 1980 and 2017.

Figure 3
Abnormal performance of silent R&D firms

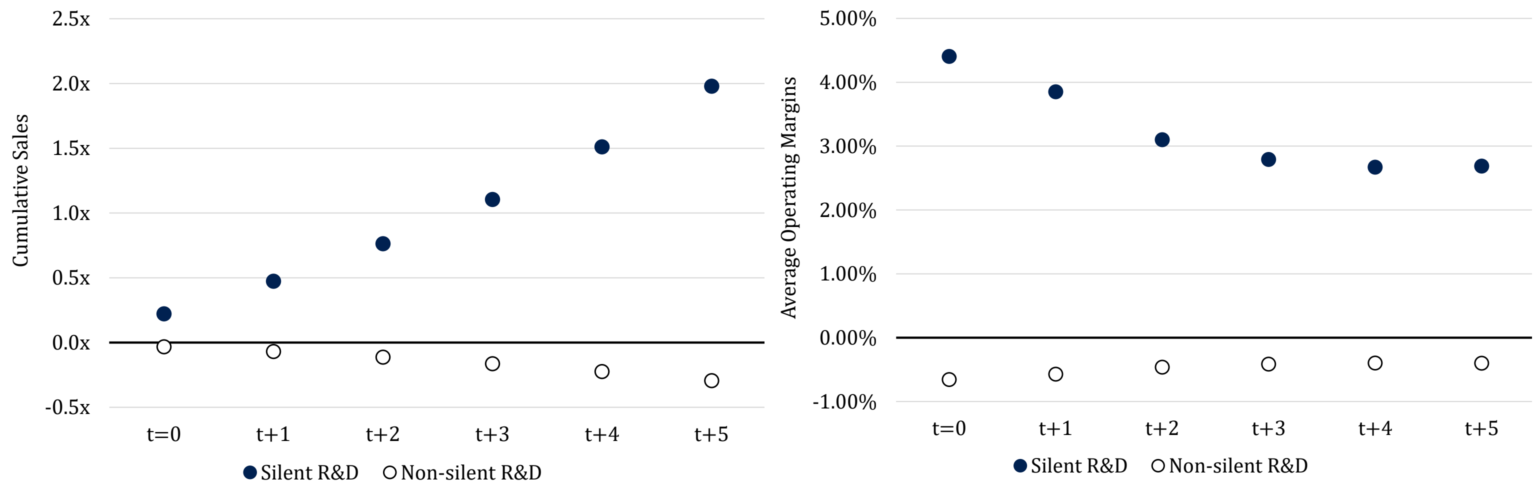


This figure shows the abnormal performance of silent R&D (solid dots) and non-silent R&D (hollow dots) firms over time. Silent R&D firms are firms with missing R&D that report SG&A and operate in industries where the majority of firms report R&D. Non-silent R&D firms are firms not classified as silent R&D firms. Cumulative profitability is the operating income before intangible investment accumulated over the next t=1,...,5 years, per dollar of the beginning-of-period capital at t=0. Cumulative profitability is presented relative to industry-year means. The sample includes 108,266 firm-year observations from R&D-reporting industries between 1980 and 2015 with non-missing data for at least five periods out.

Figure 4

Sales and margins of silent R&D firms

Panel A: Cumulative sales. **Panel B: Operating margins.**

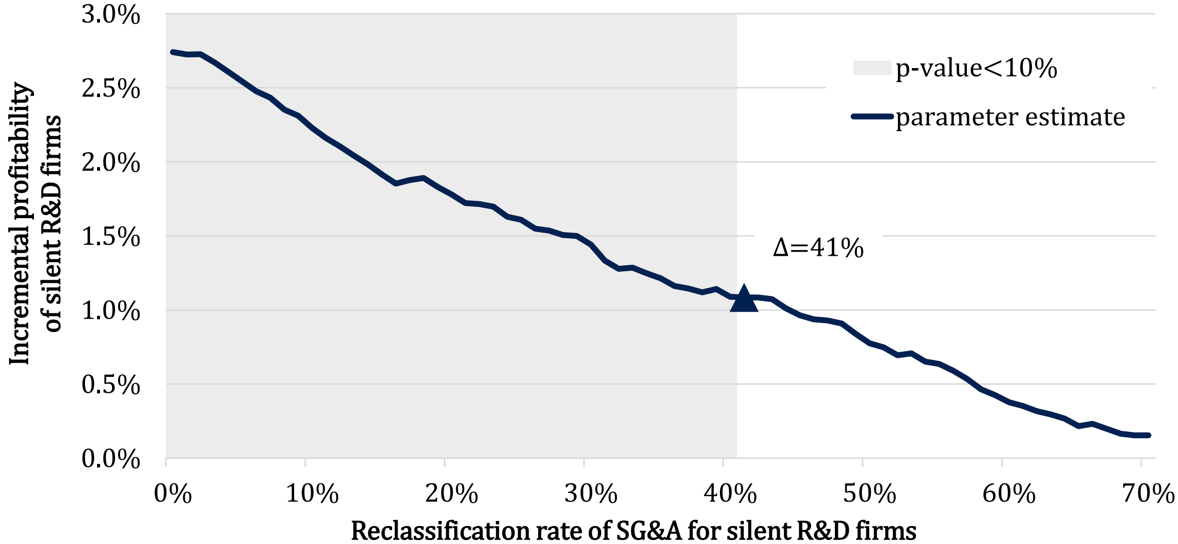


This figure shows sales and margins of silent R&D (solid dots) and non-silent R&D (hollow dots) firms over time. Panel A shows cumulative sales over time relative to industry-year means. Cumulative sales are sales accumulated over the next t=1,…,5 years, per dollar of the beginning-of-period capital at t=0. Panel B shows average operating margins over time relative to industry-year means. Average operating margins are calculated operating income before intangible investment accumulated over the next t=1,…,5 years, per dollar accumulated sales over the same period. The sample includes 108,266 firm-year observations from R&D-reporting industries between 1980 and 2015 with non-missing data for at least five periods out.

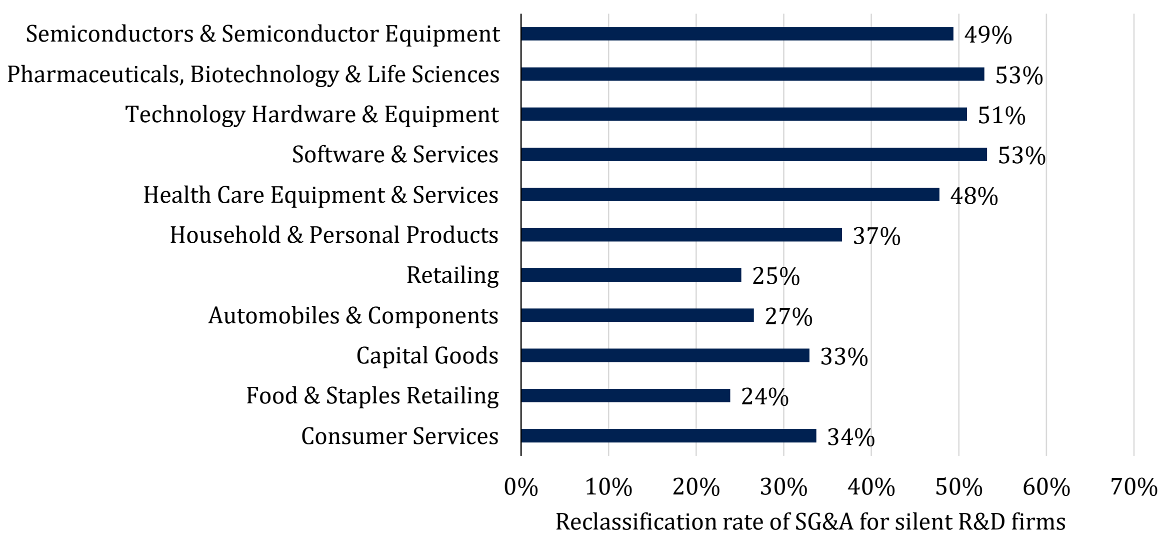
Figure 5

Reclassification rates of SG&A for silent R&D firms

Panel A. Fixed rate



Panel B. Industry-specific rates



This figure shows the estimates of the reclassification rates of SG&A for silent R&D firms. Reclassification rate, denoted Δ, is the incremental fraction of SG&A expense in silent R&D firms that constitutes an R&D investment. Panel A assumes fixed reclassification rate and reports relationship between assumed reclassification rate and the estimated profitability difference between silent and non-silent R&D firms. Panel B allows for different reclassification rate depending on the GICS industry and reports the reclassification rate that explains the profitability difference between silent and non-silent R&D firms. The profitability difference is estimated as the coefficient on the indicator for silent R&D firms, $I(Silent\ R\&D_{it})$, from the regression of future profitability as in Table 3, Model 3.

Table 1
Descriptive Statistics

Panel A: Empirical distributions

	Mean	Sd.	Min	P1	P25	P50	P75	P99	Max
$Sales_{it}$	1.143	0.839	0.010	0.039	0.570	0.962	1.489	4.238	5.936
$Sales_{it+1,t+3}$	4.187	3.501	0.056	0.154	1.892	3.300	5.370	17.895	28.555
$Profitability_{it}$	0.099	0.143	-0.465	-0.297	0.024	0.101	0.177	0.485	0.654
$Profitability_{it+1,t+3}$	0.360	0.561	-1.729	-0.969	0.049	0.307	0.605	2.256	3.470
$R\&D_{it}$	0.028	0.051	-0.031	0.000	0.000	0.000	0.039	0.227	0.976
$SG\&A_{it}$	0.219	0.174	-0.705	0.000	0.096	0.187	0.301	0.801	2.223
$IntInv_{it}$	0.113	0.107	-0.091	-0.025	0.044	0.092	0.148	0.556	0.926
$log(MV_{it-1})$	5.152	2.431	-6.674	0.130	3.375	5.015	6.812	11.022	13.348
$log(age_{it})$	2.839	0.854	0.000	0.000	2.398	2.944	3.434	4.595	5.176
$Leverage_{it-1}$	0.214	0.195	0.000	0.000	0.036	0.175	0.341	0.737	0.806
Q_{it-1}	1.419	1.149	0.193	0.256	0.725	1.082	1.690	6.258	9.715
$I(Silent\ R\&D_{it})$	0.129	0.335	0.000	0.000	0.000	0.000	0.000	1.000	1.000

Panel B: Sample differences

	$I(Silent\ R\&D_{it}) = 1$		$I(Silent\ R\&D_{it}) = 0$		Comparison	
	Mean	Sd.	Mean	Sd.	Diff.	t-stat
$Sales_{it}$	1.528	0.935	1.086	0.808	0.442***	58.081
$Sales_{it+1,t+3}$	5.684	4.200	3.965	3.328	1.719***	50.677
$Profitability_{it}$	0.115	0.137	0.096	0.143	0.019***	16.419
$Profitability_{it+1,t+3}$	0.425	0.560	0.350	0.561	0.075***	16.270
$R\&D_{it}$	0.000	0.000	0.033	0.054	-0.033***	-203.965
$SG\&A_{it}$	0.288	0.195	0.209	0.169	0.079***	49.876
$IntInv_{it}$	0.110	0.109	0.113	0.107	-0.003***	-2.795
$log(MV_{it-1})$	4.522	2.293	5.246	2.437	-0.724***	-37.848
$log(age_{it})$	2.834	0.856	2.840	0.853	-0.006	-0.780
$Leverage_{it-1}$	0.243	0.195	0.210	0.195	0.033***	20.660
Q_{it-1}	1.324	1.121	1.433	1.153	-0.110***	-11.777

This table presents descriptive statistics. Panel A reports the empirical distributions of key variables. Panel B reports the comparison of means for silent R&D and non-silent R&D firms. The sample includes 129,810 firm-year observations between 1980 and 2017.

Table 2

Correlations

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1)	$Sales_{it}$		0.85***	0.44***	0.33***	-0.26***	0.38***	0.11***	-0.01***	0.08***	0.06***	-0.01***	0.18***
(2)	$Sales_{it+1,t+3}$	0.88***		0.42***	0.54***	-0.20***	0.36***	0.16***	-0.04***	0.01***	0.03***	0.05***	0.16***
(3)	$Profitability_{it}$	0.52***	0.52***		0.68***	-0.07***	0.21***	0.15***	0.28***	0.10***	0.01***	0.22***	0.04***
(4)	$Profitability_{it+1,t+3}$	0.41***	0.61***	0.73***		-0.08***	0.17***	0.13***	0.21***	0.07***	0.00	0.19***	0.05***
(5)	$R\&D_{it}$	-0.29***	-0.25***	-0.08***	-0.08***		-0.03***	0.47***	0.00	-0.13***	-0.33***	0.20***	-0.21***
(6)	$SG\&A_{it}$	0.42***	0.39***	0.22***	0.15***	0.02***		0.52***	-0.19***	-0.07***	-0.24***	0.07***	0.15***
(7)	$IntInv_{it}$	0.15***	0.18***	0.19***	0.13***	0.47***	0.66***		-0.02***	-0.09***	-0.28***	0.20***	-0.01***
(8)	$log(MV_{it-1})$	0.00	0.00	0.31***	0.28***	0.04***	-0.21***	-0.05***		0.38***	0.11***	0.27***	-0.10***
(9)	$log(age_{it})$	0.15***	0.08***	0.09***	0.10***	-0.04***	-0.03***	-0.08***	0.40***		0.03***	-0.15***	0.00
(10)	$Leverage_{it-1}$	0.13***	0.09***	0.03***	0.04***	-0.35***	-0.23***	-0.36***	0.12***	0.06***		-0.13***	0.06***
(11)	Q_{it-1}	-0.02***	0.04***	0.35***	0.28***	0.08***	-0.06***	0.11***	0.42***	-0.11***	-0.06***		-0.03***
(12)	$I(Silent\ R\&D)_{it}$	0.19***	0.17***	0.04***	0.04***	-0.35***	0.16***	-0.01***	-0.10***	0.00	0.06***	-0.05***	

This table shows Pearson (Spearman) pairwise correlations above (below) the main diagonal. *** indicates statistical significance at the 1% level based on two-tailed tests. The sample includes 129,810 firm-year observations between 1980 and 2017.

Table 3
Intangible productivity of silent R&D firms

	$Dependent\ Variable\ =\ Profitability_{it+1,t+3}$			
	(1)	(2)	(3)	(4)
$I(Silent\ R\&D_{it})$	0.0450***	0.0036	0.0274***	-0.0007
	(3.50)	(0.25)	(4.56)	(-0.09)
$IntInv_{it}$	.	0.7358***	0.0879**	0.0511
	.	(10.99)	(2.62)	(1.43)
$I(Silent\ R\&D_{it}) \times IntInv_{it}$	.	0.5030***	.	0.2449***
	.	(6.10)	.	(4.36)
$Profitability_{it}$	.	.	2.5934***	2.5918***
	.	.	(57.25)	(57.19)
$log(MV_{it-1})$	.	.	0.0097***	0.0096***
	.	.	(7.97)	(7.94)
$log(age_{it})$	.	.	0.0011	0.0013
	.	.	(0.33)	(0.38)
$Leverage_{it-1}$	.	.	-0.0187*	-0.0190*
	.	.	(-1.79)	(-1.81)
Q_{it-1}	.	.	0.0169***	0.0171***
	.	.	(5.10)	(5.17)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	3.1%	5.3%	48.3%	48.3%
N	129,810	129,810	129,810	129,810

This table examines the intangible productivity of silent R&D firms. Silent R&D firms are firms with missing R&D that report SG&A and operate in industries where the majority of firms report R&D. The intangible productivity is measured as a coefficient on intangible investment in the regression of future profitability. The intangible investment is the sum of investment in balance-sheet intangibles plus R&D plus a fraction of SG&A expense per dollar of net operating assets. The models include industry and year fixed effects to control for industry-specific and aggregate time-varying factors. The t-statistics (in parentheses) are based on standard errors clustered by firm and year. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively, based on two-tailed tests. The sample includes 129,810 firm-year observations between 1980 and 2017.

Table 4

Profitability decomposition into growth and margins

	Dependent Variable =			
	$Sales_{it+1,t+3}$		$Margin_{it+1,t+3}$	
	(1)	(2)	(3)	(4)
$I(Silent\ R\&D_{it})$	0.2003***	0.0145	0.0366***	0.0157*
	(5.38)	(0.31)	(5.88)	(1.95)
$IntInv_{it}$	1.8639***	1.6215***	-0.0321	-0.0598
	(16.48)	(13.07)	(-1.01)	(-1.64)
$I(Silent\ R\&D_{it}) \times IntInv_{it}$	.	1.6302***	.	0.1820***
	.	(6.17)	.	(4.61)
$Dep.Var._{it}$	3.4960***	3.4917***	0.3568***	0.3567***
	(81.83)	(81.30)	(23.95)	(23.95)
$log(MV_{it-1})$	-0.0200***	-0.0206***	0.0346***	0.0346***
	(-3.89)	(-4.04)	(18.77)	(18.79)
$log(age_{it})$	-0.1487***	-0.1474***	0.0236***	0.0237***
	(-9.50)	(-9.44)	(5.46)	(5.49)
$Leverage_{it-1}$	-0.1391**	-0.1402**	0.0866***	0.0864***
	(-2.57)	(-2.58)	(6.25)	(6.22)
Q_{it-1}	0.1570***	0.1579***	-0.0151***	-0.0150***
	(10.85)	(11.03)	(-3.51)	(-3.50)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	73.6%	73.7%	30.5%	30.5%
N	129,810	129,810	129,810	129,810

This table examines the intangible productivity of silent R&D firms. The intangible productivity is measured as a coefficient on intangible investment in the regression of future sales and margins. Models (1) and (2) explain future sales accumulated over the next three periods, scaled by beginning-of-period capital. Models (3) and (4) explain operating margins (operating profit before SG&A and R&D investment per dollar of sales) averaged over the next three periods and winsorized at ±1,000%. All models include industry and year fixed effects to control for industry-specific and aggregate time-varying factors. The t-statistics (in parentheses) are based on standard errors clustered by firm and year. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively, based on two-tailed tests. The sample includes 129,810 firm-year observations between 1980 and 2017.

Table 5

Silent R&D performance across alternative comparison samples

	Dependent Variable $= Profitability_{it+1,t+3}$					
	Industry matching		p-score matching		entropy balancing	
	(1)	(2)	(3)	(4)	(5)	(6)
$I(Silent\ R\&D_{it})$	0.0260***	-0.0103	0.0287***	-0.0003	0.0239***	-0.0058
	(4.36)	(-1.30)	(3.94)	(-0.03)	(3.89)	(-0.72)
$IntInv_{it}$	0.0257	-0.0472	0.1455**	0.0072	0.1552***	0.0194
	(0.69)	(-1.12)	(2.62)	(0.09)	(3.54)	(0.37)
$I(Silent\ R\&D_{it}) \times IntInv_{it}$	.	0.3120***	.	0.2584***	.	0.2689***
	.	(5.40)	.	(3.05)	.	(4.30)
$Profitability_{it}$	2.6610***	2.6575***	2.6058***	2.6083***	2.5543***	2.5520***
	(58.44)	(58.20)	(49.79)	(49.71)	(52.70)	(52.79)
$log(MV_{it-1})$	0.0118***	0.0117***	0.0108***	0.0106***	0.0111***	0.0110***
	(8.45)	(8.40)	(5.98)	(5.92)	(6.48)	(6.44)
$log(age_{it})$	-0.0052	-0.0051	-0.0064	-0.0062	-0.0061	-0.0055
	(-1.11)	(-1.10)	(-1.31)	(-1.27)	(-1.29)	(-1.18)
$Leverage_{it-1}$	-0.0276*	-0.0278*	-0.0621***	-0.0629***	-0.0402**	-0.0426***
	(-2.01)	(-2.02)	(-3.32)	(-3.37)	(-2.61)	(-2.75)
Q_{it-1}	0.0172***	0.0177***	0.0237***	0.0237***	0.0266***	0.0268***
	(4.02)	(4.17)	(4.19)	(4.22)	(4.87)	(4.93)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	50.6%	50.6%	48.1%	48.1%	46.5%	46.6%
N	75,960	75,960	33,532	33,532	129,810	129,810

This table examines the intangible productivity of silent R&D firms for three different comparison samples. Columns (1) and (2) show results for the subsample of R&D reporting industries. R&D reporting industries are industries where the majority of firms report R&D. Columns (3) and (4) show results for the sample of silent firms with p-score-matched sample of control firms. Columns (5) and (6) show results for the full sample of firms after using entropy balancing to adjust for covariate imbalance between silent R&D and control firms. All models include industry and year fixed effects to control for industry-specific and aggregate time-varying factors. The t-statistics (in parentheses) are based on standard errors clustered by firm and year. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively, based on two-tailed tests. The sample of firms in the R&D reporting industries includes 75,960 firm-year observations. The p-scored matched sample of firms includes 33,532 firm-year observations. The full sample includes 129,810 firm-year observations between 1980 and 2017.

Table 6

Cross-sectional variation: SG&A reclassification thresholds

	$Dependent\ Variable\ =\ Profitability_{it+1,t+3}$					
	$SG\&A - E(SG\&A) > 0$		$SG\&A - E(SG\&A) > 5\%$		$SG\&A - E(SG\&A) > 10\%$	
	(1)	(2)	(3)	(4)	(5)	(6)
$I(Silent\ R\&D_{it})$	0.0330***	-0.0051	0.0353***	-0.0136	0.0459***	-0.0126
	(4.46)	(-0.51)	(4.01)	(-1.04)	(4.22)	(-0.71)
$IntInv_{it}$	0.0789**	0.0549	0.0772**	0.0553	0.0751**	0.0567*
	(2.39)	(1.67)	(2.34)	(1.67)	(2.27)	(1.71)
$I(Silent\ R\&D_{it}) \times IntInv_{it}$	.	0.2614***	.	0.3040***	.	0.3285***
	.	(3.60)	.	(3.51)	.	(3.16)
$Profitability_{it}$	2.5926***	2.5918***	2.5929***	2.5921***	2.5924***	2.5918***
	(56.96)	(56.96)	(56.84)	(56.83)	(56.81)	(56.79)
$log(MV_{it-1})$	0.0096***	0.0096***	0.0095***	0.0095***	0.0095***	0.0095***
	(7.75)	(7.75)	(7.69)	(7.70)	(7.70)	(7.71)
$log(age_{it})$	0.0012	0.0013	0.0012	0.0014	0.0013	0.0014
	(0.34)	(0.38)	(0.36)	(0.40)	(0.38)	(0.41)
$Leverage_{it-1}$	-0.0149	-0.0165	-0.0145	-0.0161	-0.0144	-0.0159
	(-1.41)	(-1.55)	(-1.36)	(-1.51)	(-1.35)	(-1.48)
Q_{it-1}	0.0170***	0.0170***	0.0170***	0.0170***	0.0170***	0.0170***
	(5.14)	(5.16)	(5.14)	(5.15)	(5.13)	(5.14)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	48.3%	48.3%	48.3%	48.3%	48.3%	48.3%
N	129,810	129,810	129,810	129,810	129,810	129,810
% Silent R&D	7.0%	7.0%	5.2%	5.2%	3.8%	3.8%

This table examines the intangible productivity of silent R&D firms using three different materiality thresholds for silent R&D firms based on the level of abnormal SG&A. Abnormal SG&A is reported SG&A less expected SG&A, where expected SG&A is median SG&A of the R&D-reporting firms in the same year, industry, and market capitalization quintile. Silent R&D firms are firms with missing R&D that report SG&A and operate in industries where the majority of firms report R&D. In Columns (1) and (2), silent R&D firms also require abnormal SG&A greater than 0. In Columns (3) and (4), silent R&D firms also require abnormal SG&A greater than 5% of beginning-of-period capital. In Columns (5) and (6), silent R&D firms also require abnormal SG&A greater than 10% of beginning-of-period capital. All models include industry and year fixed effects to control for industry-specific and aggregate time-varying factors. The t-statistics (in parentheses) are based on standard errors clustered by firm and year. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively, based on two-tailed tests. The sample of firms in the R&D reporting industries includes 75,960 firm-year observations. The p-scored matched sample of firms includes 33,532 firm-year observations. The sample includes 129,810 firm-year observations between 1980 and 2017.

Table 7
Alternative R&D and SG&A capitalization schemes

	$Dependent\ Variable\ =\ Profitability_{it+1,t+3}$					
	Peters and Taylor (2017)		Ewens et al. (2020)		Iqbal et al. (2021)	
	(1)	(2)	(3)	(4)	(5)	(6)
$I(Silent\ R\&D_{it})$	0.0274***	-0.0007	0.0313***	-0.0010	0.0275***	0.0105
	(4.56)	(-0.09)	(5.13)	(-0.12)	(4.47)	(1.28)
$IntInv_{it}$	0.0879**	0.0511	0.0110	-0.0263	0.1219***	0.1005***
	(2.62)	(1.43)	(0.32)	(-0.72)	(4.14)	(3.31)
$I(Silent\ R\&D_{it}) \times IntInv_{it}$	.	0.2449***	.	0.2793***	.	0.1493**
	.	(4.36)	.	(4.69)	.	(2.53)
$Profitability_{it}$	2.5934***	2.5918***	2.5863***	2.5829***	2.5713***	2.5695***
	(57.25)	(57.19)	(59.48)	(59.32)	(54.87)	(54.77)
$log(MV_{it-1})$	0.0097***	0.0096***	0.0114***	0.0114***	0.0121***	0.0121***
	(7.97)	(7.94)	(8.77)	(8.77)	(9.13)	(9.13)
$log(age_{it})$	0.0011	0.0013	0.0040	0.0043	0.0025	0.0026
	(0.33)	(0.38)	(1.10)	(1.18)	(0.69)	(0.72)
$Leverage_{it-1}$	-0.0187*	-0.0190*	-0.0260**	-0.0265**	-0.0220**	-0.0221**
	(-1.79)	(-1.81)	(-2.38)	(-2.42)	(-2.07)	(-2.08)
Q_{it-1}	0.0169***	0.0171***	0.0105***	0.0106***	0.0122***	0.0123***
	(5.10)	(5.17)	(3.13)	(3.19)	(3.76)	(3.81)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	48.3%	48.3%	49.4%	49.4%	48.9%	48.9%
N	129,810	129,810	129,886	129,886	129,954	129,954

This table examines the intangible productivity of silent R&D firms using three different methods of measuring intangible capital and investment. Columns (1) and (2) are baseline results using Peters and Taylor (2017) data. Columns (3) and (4) uses Ewens et al. (2020) industry-specific data for intangible capital and a fraction of SG&A used to measure intangible investment. Columns (5) and (6) additionally use Iqbal et al. (2021) adjustment for the industry-specific fraction of R&D expense to measure knowledge capital. All models include industry and year fixed effects to control for industry-specific and aggregate time-varying factors. The t-statistics (in parentheses) are based on standard errors clustered by firm and year. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively, based on two-tailed tests. The main sample includes 129,810 observations between 1980 and 2017.

Table 8

Total investment productivity of silent R&D firms

	$Dependent\ Variable\ =\ Profitability_{it+1,t+3}$					
	Total Investment		Physical Investment		Intangible Investment	
	(1)	(2)	(3)	(4)	(5)	(6)
$I(Silent\ R\&D_{it})$	0.0268***	-0.0067	0.0252***	0.0121**	0.0274***	-0.0007
	(4.59)	(-1.05)	(4.30)	(2.07)	(4.56)	(-0.09)
$Investment_{it}$	0.0855***	0.0612***	0.0948**	0.0737*	0.0879**	0.0511
	(4.21)	(2.95)	(2.64)	(1.93)	(2.62)	(1.43)
$I(Silent\ R\&D_{it})$	.	0.1802***	.	0.1827***	.	0.2449***
$\times\ Investment_{it}$	.	(5.26)	.	(3.31)	.	(4.36)
$Profitability_{it}$	2.5791***	2.5778***	2.5884***	2.5881***	2.5934***	2.5918***
	(58.37)	(58.45)	(57.15)	(57.18)	(57.25)	(57.19)
$log(MV_{it-1})$	0.0096***	0.0096***	0.0094***	0.0094***	0.0097***	0.0096***
	(7.86)	(7.82)	(7.69)	(7.68)	(7.97)	(7.94)
$log(age_{it})$	0.0024	0.0025	0.0018	0.0018	0.0011	0.0013
	(0.73)	(0.75)	(0.54)	(0.54)	(0.33)	(0.38)
$Leverage_{it-1}$	-0.0213**	-0.0211**	-0.0281**	-0.0281**	-0.0187*	-0.0190*
	(-2.11)	(-2.10)	(-2.63)	(-2.64)	(-1.79)	(-1.81)
Q_{it-1}	0.0158***	0.0160***	0.0166***	0.0166***	0.0169***	0.0171***
	(4.63)	(4.68)	(4.78)	(4.79)	(5.10)	(5.17)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	48.3%	48.4%	48.3%	48.3%	48.3%	48.3%
N	129,810	129,810	129,810	129,810	129,810	129,810

This table examines the total investment productivity of silent R&D firms. Models (1) and (2) examine the productivity of the total investment, measured as a sum of physical and intangible investment. Models (3) and (4) examine the productivity of the physical investment measured as change in net property, plant, and equipment (PP&E) plus depreciation per beginning-of-period capital. Models (5) and (6) examine the productivity of the intangible investment measured as change in the balance-sheet intangibles plus amortization plus R&D plus a fraction of SG&A per beginning-of-period capital. All models include industry and year fixed effects to control for industry-specific and aggregate time-varying factors.The t-statistics (in parentheses) are based on standard errors clustered by firm and year. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively, based on two-tailed tests. The sample includes 129,810 firm-year observations between 1980 and 2017.

Table 9

Cross-sectional variation: Silent R&D and 10-K secrecy

	$Dependent\ Variable\ =\ Profitability_{it+1,t+3}$			
	No 10-K Secrecy		10-K Secrecy	
	(1)	(2)	(3)	(4)
$I(Silent\ R\&D_{it})$	0.0292***	-0.0015	0.0331***	0.0036
	(2.87)	(-0.13)	(3.06)	(0.35)
$IntInv_{it}$	0.0870*	0.0400	0.0325	0.0054
	(1.87)	(0.91)	(0.88)	(0.12)
$I(Silent\ R\&D_{it}) \times IntInv_{it}$	.	0.2696***	.	0.2234**
	.	(3.45)	.	(2.52)
$Profitability_{it}$	2.5114***	2.5102***	2.5868***	2.5847***
	(35.60)	(35.62)	(35.77)	(35.59)
$log(MV_{it-1})$	0.0093***	0.0091***	0.0127***	0.0127***
	(5.86)	(5.83)	(5.12)	(5.12)
$log(age_{it})$	0.0052	0.0054	0.0070	0.0070
	(1.11)	(1.15)	(1.14)	(1.15)
$Leverage_{it-1}$	-0.0108	-0.0112	-0.0057	-0.0055
	(-0.70)	(-0.73)	(-0.35)	(-0.34)
Q_{it-1}	0.0228***	0.0229***	0.0184***	0.0186***
	(5.03)	(5.06)	(3.57)	(3.62)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	47.3%	47.4%	53.5%	53.6%
N	53,514	53,514	28,226	28,226
% Silent R&D	13.4%	13.4%	9.8%	9.8%

This table examines the intangible productivity of silent R&D firms across partitions based on 10-K secrecy disclosure. 10-K secrecy firms are firms mentioning trade secrets or trade secrecy in their 10-K. Columns (1) and (2) show results for the sample of firms without 10-K secrecy mentions. Columns (3) and (4) show results for the sample of firms with 10-K secrecy mentions. All models include industry and year fixed effects to control for industry-specific and aggregate time-varying factors. The t-statistics (in parentheses) are based on standard errors clustered by firm and year. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively, based on two-tailed tests. The baseline sample includes 81,740 firm-year observations between 1995 and 2017. The sample starts in 1995 when EDGAR index files were first available.

Table 10
Cross-sectional variation: Silent R&D and patenting activity

	$Dependent\ Variable\ =\ Profitability_{it+1,t+3}$			
	Non-patenting firms		Patenting firms	
	(1)	(2)	(3)	(4)
$I(Silent\ R\&D_{it})$	0.0263***	-0.0002	0.0132	-0.0290*
	(3.63)	(-0.02)	(0.96)	(-1.80)
$IntInv_{it}$	0.1191***	0.0756**	0.0076	-0.0123
	(3.74)	(2.23)	(0.16)	(-0.25)
$I(Silent\ R\&D_{it}) \times IntInv_{it}$	.	0.2236***	.	0.4549**
	.	(3.44)	.	(2.46)
$Profitability_{it}$	2.5196***	2.5179***	2.7806***	2.7793***
	(57.26)	(57.19)	(44.20)	(44.18)
$log(MV_{it-1})$	0.0121***	0.0120***	0.0070***	0.0069***
	(8.23)	(8.18)	(3.76)	(3.74)
$log(age_{it})$	0.0045	0.0047	-0.0106*	-0.0107*
	(1.34)	(1.40)	(-1.76)	(-1.78)
$Leverage_{it-1}$	-0.0270**	-0.0272**	0.0034	0.0031
	(-2.31)	(-2.33)	(0.24)	(0.22)
Q_{it-1}	0.0175***	0.0176***	0.0148***	0.0149***
	(4.66)	(4.70)	(3.22)	(3.27)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	46.7%	46.7%	52.8%	52.8%
N	87,642	87,642	42,168	42,168
% Silent R&D	16.4%	16.4%	5.7%	5.7%

This table examines the intangible productivity of silent R&D firms across partitions based on patenting activity. Patenting firms are firms that apply for patents or are granted patents in a given year. Columns (1) and (2) show results for the sample of non-patenting firms. Columns (3) and (4) show results for the sample of patenting firms. All models include industry and year fixed effects to control for industry-specific and aggregate time-varying factors. The t-statistics (in parentheses) are based on standard errors clustered by firm and year. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively, based on two-tailed tests. The sample includes 129,810 firm-year observations between 1980 and 2017.

Table 11

Cross-sectional variation: Silent R&D and disclosure quality

	$Dependent\ Variable\ =\ Profitability_{it+1,t+3}$			
	Low DQ firms		High DQ firms	
	(1)	(2)	(3)	(4)
$I(Silent\ R\&D_{it})$	0.0314***	0.0047	0.0248***	-0.0067
	(4.34)	(0.51)	(2.99)	(-0.57)
$IntInv_{it}$	0.1259***	0.0847**	0.0447	0.0121
	(3.49)	(2.30)	(1.10)	(0.27)
$I(Silent\ R\&D_{it}) \times IntInv_{it}$	.	0.2275***	.	0.2843***
	.	(3.39)	.	(3.06)
$Profitability_{it}$	2.5216***	2.5192***	2.6543***	2.6524***
	(49.38)	(49.42)	(56.72)	(56.58)
$log(MV_{it-1})$	0.0103***	0.0103***	0.0100***	0.0099***
	(7.33)	(7.28)	(6.52)	(6.51)
$log(age_{it})$	-0.0020	-0.0019	0.0033	0.0034
	(-0.53)	(-0.49)	(0.72)	(0.76)
$Leverage_{it-1}$	-0.0047	-0.0049	-0.0258*	-0.0257*
	(-0.36)	(-0.37)	(-1.83)	(-1.83)
Q_{it-1}	0.0155***	0.0156***	0.0166***	0.0167***
	(3.84)	(3.89)	(4.78)	(4.84)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	46.8%	46.9%	49.1%	49.2%
N	65,103	65,103	64,707	64,707
% Silent R&D	14.8%	14.8%	11.0%	11.0%

This table examines the intangible productivity of silent R&D firms across partitions based on disclosure quality. The disclosure quality is measured using DQ measure of Chen et al. (2015). High (low) DQ firms are firms with DQ above (below) industry-year median breakpoints. Columns (1) and (2) show results for the sample of firms with low DQ. Columns (3) and (4) show results for the sample of firms with high DQ. All models include industry and year fixed effects to control for industry-specific and aggregate time-varying factors. The t-statistics (in parentheses) are based on standard errors clustered by firm and year. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively, based on two-tailed tests. The sample includes 129,810 firm-year observations between 1980 and 2017.

Table 12

Investment-Q sensitivity in silent R&D firms

	Dependent Variable = $Investment_{it}$				
	Total	*Physical*	*B/S Intan.*	*R&D*	*SG&A*
	(1)	(2)	(3)	(4)	(5)
$I(Silent\ R\&D_{it})$	-0.0082*	0.0008	-0.0059***	-0.0121***	0.0090***
	(-1.87)	(0.29)	(-2.98)	(-11.10)	(4.66)
Q_{it-1}	0.0312***	0.0181***	0.0046***	0.0052***	0.0034***
	(26.61)	(18.99)	(9.85)	(19.06)	(12.39)
$I(Silent\ R\&D_{it}) \times Q_{it-1}$	0.0041*	0.0003	0.0066***	-0.0061***	0.0033***
	(1.82)	(0.20)	(5.25)	(-13.78)	(4.65)
CF_{it}	0.3390***	0.2147***	0.0648***	0.0041*	0.0554***
	(10.89)	(10.57)	(9.32)	(1.86)	(9.14)
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
R^2	31.1%	41.3%	13.1%	77.4%	73.9%
N	129,810	129,810	129,810	129,810	129,810

This table examines the investment of silent R&D firms. Total investment is the sum of physical investment and intangible investment. Physical investment is change in net property, plant, and equipment (PP&E) plus depreciation per dollar of beginning-of-period capital. Investment in balance-sheet intangibles is change in reported intangibles plus amortization per dollar of beginning-of-period capital. R&D investment is R&D per dollar of beginning-of-period capital. SG&A investment is fraction of SG&A per dollar of beginning-of-period capital. Tobin's Q is measured as the market value of equity plus book value of long-term and short-term debt plus book value of preferred stock divided by book value of capital. CF is measured as after-tax income before extraordinary items plus depreciation and amortization plus SG&A and R&D investment per dollar of beginning-of-period capital and winsorized at $\pm$1,000%. All models include firm and year fixed effects to control for firm-specific and aggregate time-varying factors. The t-statistics (in parentheses) are based on standard errors clustered by firm and year. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively, based on two-tailed tests. The baseline sample includes 129,810 firm-year observations between 1980 and 2017.

Appendix 3

Additional Analysis

A3.1. R&D intensity in R&D-reporting industries

To identify silent R&D firms, I require that the firm operates in the R&D-reporting industry, has missing R&D expense, and has positive SG&A expense. R&D-reporting industries are industries where at least 50% of firm-year observations have non-missing R&D expense. I focus on R&D-reporting industries because firms in R&D-reporting industries are more likely to be intangible-intensive. In this section, I show that firms in R&D-reporting industries have higher R&D intensity.

Figure A1 shows R&D intensity over time for R&D-reporting industries relative to the remaining industries (not classified as R&D-reporting). The dark line shows that the average R&D-to-sales ratio in the R&D-reporting industries increased from about 2.4% in 1980 to 35.5% in 2017. In contrast, the light line shows that the average R&D-to-sales in non-R&D-reporting industries remained constant at about 1.7%. These results imply that, on aggregate, the proportion of R&D-reporting firms reflects differences in the intangible intensity across industries. This relationship arises because R&D reporting requires that R&D investment passes a materiality threshold.

In summary, the results in Figure A1 confirm that R&D-reporting industries have significantly higher R&D intensity.

A3.2. Intangible investment components

In this section, I decompose the baseline intangible investment measure into two components: the balance sheet intangible investment and off-balance sheet intangible investment (R&D and SG&A investment). I show that the higher future profitability of silent R&D firms is explained primarily by the productivity of the pooled SG&A component.

In Table A1, I report the results of profitability regressions using alternative intangible investment rates. In Columns (1) and (2) I report my baseline results for the total intangible investment. I find that higher productivity of the intangible investment explains the incremental productivity of silent R&D firms, which means that the outperformance of silent R&D firms is driven primarily by the higher productivity of their intangible capital. In Columns (3) and (4), I examine the balance sheet intangible investment component, measured as the change in the externally acquired intangibles recognized on the balance sheet plus amortization per beginning-of-period capital. In Column (3), the coefficient on the indicator for silent R&D firms is 0.0241, significant at the 1% level. This estimate implies that future profitability, accumulated over the next three years, is almost 2.5 percentage points higher for silent R&D firms. This estimate is comparable to the corresponding estimate in Column (2). In Column (4), the coefficient on the interaction term is 0.1169, significant at the 5% level. This estimate implies that incremental productivity in silent R&D firms is 12 cents from every dollar of balance sheet intangible investment. The coefficient on the indicator for silent R&D firms in this specification is 0.0213, significant at the 1% level. This result means that although balance sheet intangible investment is more productive in the silent R&D firms, the difference in the productivity of this component is not enough to explain fully the profitability difference between silent and non-silent R&D firms. In Columns (5) and (6), I separately examine the off-balance sheet intangible investment component, measured as R&D plus a fraction of SG&A per beginning-of-period capital. In Column (5), the coefficient on the indicator for silent R&D firms is 0.0204, significant at the 1% level. This estimate implies that future profitability, accumulated over the next three years, is 2 percentage points higher for silent R&D firms. In Column (6), the coefficient on the interaction term is 0.3788, significant at the 1% level. This estimate implies that incremental productivity in silent R&D firms is 48 cents from every dollar of the pooled SG&A investment.

In summary, the results in Table A2 show that intangible productivity of silent R&D firms is driven primarily by the pooled SG&A component. However, balance sheet intangible investment is also more productive in silent R&D firms.

A3.3. Boundaries of the firm

In this section, I check whether silent R&D is associated with substitution away from internally organized research projects into M&A or joint ventures (Robinson 2008). I find that silent R&D is associated with a lower likelihood of joined venture or R&D agreements. I also find that silent R&D firms are more likely to engage in M&A and that the productivity of M&A investment is higher in silent R&D firms.

In Table A2, I report the results of logistic regressions examining the association between silent R&D and the likelihood of engaging in M&As, joint ventures, and R&D agreements. In Column (1), I report the results of linear regression of indicator for M&A activity on silent R&D and a set of control variables related to profitability and investment of silent R&D firms. The coefficient on the indicator for silent R&D firms is 0.2603, significant at the 1% level. This estimate means that silent R&D firms are associated with a $e^{2603} \approx 1.3$ higher odds of M&A activity in a given year relative to non-silent R&D firms. M&A activity is also positively associated with the intangible investment, profitability, market value, age, and leverage. This result implies that silent R&D firms are more likely to engage in M&A, possibly with an intention to obtain synergies from combining innovative capabilities (Bena and Li, 2014) or to access human capital (Chen et al. 2020). In Column (2) I report the results of linear regression of indicator for joint venture activity on silent R&D and a set of control variables related to profitability and investment of silent R&D firms. Joint venture activity is defined broadly to also include strategic alliances and research agreements. The coefficient on the indicator for silent R&D firms is -0.4610, significant at the 1% level. This estimate means that silent R&D firms are associated with a $1 - e^{-0.4610} \approx 0.4$ lower odds of joint venture activity in a given year relative to non-silent R&D firms. This result implies that silent firms will be less likely to participate in knowledge-sharing externally-organized projects. In Column (3), I report the results of linear regression of indicator for external R&D activity (R&D agreements) on silent R&D and a set of control variables related to profitability and investment of silent R&D firms. R&D agreements are a subset of joint ventures that focus on joint research and/or development activity. The coefficient on the indicator for silent R&D firms is -1.0619, significant at the 1% level. This estimate means that silent R&D firms are associated with a $1 - e^{-1.0619} \approx 0.7$ lower odds of external R&D agreements in a given year relative to non-silent R&D firms. This result implies that silent firms will be less likely to participate in knowledge-sharing externally-organized R&D projects. Overall, the results in Table A3 show that silent R&D firms are more likely to engage in M&A but are less likely to participate in external knowledge-sharing projects.[11]

In Table A3 I examine M&A productivity of the silent R&D firms. Given that Silent R&D firms engage more in M&A activity, I test whether M&A investment is associated with higher future profitability of the acquiring firms. I measure M&A investment using the dollar value of acquisitions reported in SDC data. To measure M&A investment, I restrict the sample of all deals to only focus on transactions with deal value of at least $1 million and with a post-transaction percent ownership of the target company of at least 50%. Column (1) shows the results from the baseline profitability regression as reported in Table 3, Column (1). Column (2) shows the results from the profitability regression that additionally includes M&A investment and interaction of M&A investment with the indicator for silent R&D firms. The coefficient on the interaction term between indicator for silent R&D firms and intangible investment is 0.4630, significant at the 1% level. This estimate implies that silent R&D firms have higher productivity of M&A investment relative to non-silent R&D firms. The coefficient on the indicator for silent R&D firms in this specification is 0.0323, significant at the 5% level. This result means that although M&A investment is more productive in the silent R&D firms, the difference in the productivity of this component is not enough to explain fully the profitability difference between silent and non-silent R&D firms. In Columns (3) and (4), I repeat the tests after including remaining control variables. In Column (3), the coefficient on the indicator for silent R&D firms is 0.0257, significant at the 1% level. This estimate implies that future profitability, accumulated over the next three years, is almost 3 percentage points higher for silent R&D firms. This estimate is comparable to the corresponding estimate in Table 3, Column (3). In Column (4), the coefficient on the interaction term between indicator for silent R&D firms and intangible investment is 0.1537, significant at the 1% level. This estimate implies that silent R&D firms have higher productivity of M&A investment relative to non-silent R&D firms. The coefficient on the indicator for silent R&D firms in this specification is 0.0216, significant at the 1% level. This result means that although M&A investment is more productive in silent R&D firms, the difference in the productivity of M&A investment is not enough to explain the profitability difference between silent and non-silent R&D firms. These results align with evidence reported in Table A2, which shows that balance-sheet investment in externally-acquired intangibles (a balance sheet measure of M&A investment) is more productive in silent R&D firms. However, the difference in the

[11] I note that using ordinary least squares, as opposed to logistic regression, to estimate these relationships provides consistent evidence. Specifically, the coefficients on the indicator for silent R&D firms is positive and statistically significant in the regression of indicator for M&A activity, and negative and statistically significant in the regressions of indicators for joint venture and R&D agreement activities regardless of the estimation method. Similarly, using untransformed variables (size of acquisitions and the number of joint venture or R&D deals) in the linear regressions also provides consistent evidence. Specifically, the coefficients on the indicator for silent R&D firms is positive and statistically significant in the regression of total dollar value of acquisitions, and negative and statistically significant in the regressions of the number of joint venture and R&D agreement agreements.

productivity of that component does not explain fully the profitability difference between silent and non-silent R&D firms.

In summary, I find that silence is associated with a statistically significant decrease in the likelihood of participating in knowledge-sharing alliances such as joined venture or R&D agreements. I also find that silent R&D firms are more likely to engage in M&A, likely to access innovative capabilities or human capital. Accordingly, I find that the productivity of M&A investment is higher in silent R&D firms. However, the difference in the productivity of M&A investment is not enough to explain the profitability difference between silent and non-silent R&D firms.

A3.4. Silent R&D, 10-K secrecy, patenting, and disclosure quality

In my empirical analysis, I find that silent R&D is different from 10-K secrecy, it does not involve patenting, and is not reflecting poor disclosure quality. In this section, I illustrate the overlap of Silent R&D with 10-K secrecy, patenting, and disclosure quality.

Figure A2 shows the frequency of silent R&D and 10-K secrecy firms, including the overlap, by industry. The industries are ranked by frequency of R&D reporting firms from highest in the top to lowest in the bottom. The frequency of silent R&D firms is higher in the industries with a lower frequency of R&D reporting firms because silence requires not disclosing R&D. In contrast, the frequency of 10-K secrecy firms is lower in the industries with a lower frequency of R&D reporting firms. The negative correlation between silence and 10-K secrecy is consistent with Gleaser (2018), who argues that 10-K secrecy firms will also disclose R&D to communicate their innovative efforts more credibly. Silent R&D firms are a different kind of secretive firms in that they choose not to disclose R&D or secrecy, consistent with the idea of silence.

Figure A3 shows the frequency of silent R&D and patenting firms, including the overlap, by industry. The industries are ranked by frequency of R&D reporting firms from highest in the top to lowest in the bottom. The frequency of silent R&D firms is higher in the industries with a lower frequency of R&D reporting firms because silence requires not disclosing R&D. In contrast, the frequency of patenting firms is higher in the industries with a higher frequency of R&D reporting firms. The negative correlation between silence and patenting arises due to tradeoffs implicit in disclosure decisions and because process innovation is not patentable (Hall et al. 2014). The overlap between patenting and silence is consistent with the idea that some firms employ mixed intellectual property protection strategies (e.g., Graham 2004).

Figure A4 shows the frequency of silent R&D across disclosure quality partitions by industry. The industries are ranked by frequency of R&D reporting firms from highest in the top to lowest in the bottom. The frequency of silent R&D firms is higher in the industries with a lower frequency of R&D-reporting firms because silence requires not disclosing R&D. About 50% of silent R&D firms have disclosure quality above the unconditional industry-year medians and the remaining 50% below the unconditional industry-year medians. The same is true for non-silent R&D firms. The results imply that the silent R&D firms are almost equally distributed across disclosure quality partitions. This evidence shows that the lack of R&D disclosure is not reflecting poor disclosure quality.

In summary, the results in Figures A2-4 show that Silent R&D is different from 10-K secrecy, is negatively associated with patenting, and is orthogonal to the disclosure quality.

A3.5. Alternative definitions of secrecy

In my main analysis, I establish that silent R&D firms are different from 10-K secrecy firms and that silence does not require patenting. In this section, I examine future profitability and intangible productivity of 10-K secrecy firms and pseudo-R&D firms, which are alternative definitions of secrecy examined in prior work.

In Table A4, I report the results of profitability regressions using alternative definitions of secrecy. In Columns (1) and (2), I report my baseline results for silent R&D firms. I find that silent R&D firms have higher future profitability, and that the outperformance of silent R&D firms is driven primarily by the higher productivity of their intangible capital. In Columns (3) and (4), I report the results using 10-K secrecy firms of Gleaser (2018) as an alternative definition of secrecy. 10-K secrecy firms are firms mentioning trade secrets or trade secrecy in their 10-K. I find no evidence of higher future profitability or higher intangible productivity of 10-K secrecy firms. The coefficient on the indicator for silent R&D in Column (3) is small and statistically insignificant. Similarly, the coefficient on the interaction term in Column (4) is small and statistically insignificant. In Columns (5) and (6), I report the results using pseudo-R&D firms of Koh and Reeb (2015) as an alternative definition of secrecy. Pseudo-R&D firms are missing R&D firms with patenting activity. The coefficient on the indicator for silent R&D in Column (5) is small and statistically insignificant, meaning that pseudo-R&D firms are not associated with higher future profitability. In Column (6), the coefficient on the interaction term is 0.1702, significant at the 10% level. This estimate implies that the future profitability of pseudo-R&D firms is to some extent due to intangible productivity.

In summary, I do not find evidence of outperformance of 10-K secrecy or pseudo-R&D firms. This result suggests that silent R&D provides a better way of identifying firms with higher future profitability and higher intangible productivity.

A3.6. Disclosure quality components

In the main analysis, I examine variation in the profitability and productivity of silent R&D firms with disclosure quality measured with the DQ score. In this section, I separate the DQ score into the income statement and balance sheet components. I show that the results are similar to the ones using a combined score in that the silent R&D firms have higher future profitability and higher productivity of intangible investment across partitions formed on either the income-statement DQ score (DQ^{IS}) or balance-sheet DQ score (DQ^{BS}).

Table A5 explores variation across partitions based on the income-statement DQ score (DQ^{IS}). I separate firms into the partitions of low and high DQ^{IS} based on industry-year median breakpoints. In Columns (1) and (2), I test the performance of silent R&D firms within the sample of low DQ^{IS} firms. In Column (1), the coefficient on the indicator for silent

R&D firms is 0.0309, significant at the 1% level. This estimate implies that future profitability is about 3 percentage points higher for silent R&D firms in the low DQ^{IS} subsample. In Column (2), the coefficient on the interaction term is 0.2950, significant at the 1% level, meaning that silent R&D firms are more productive. In Columns (3) and (4), I test the performance of silent R&D firms within the sample of high DQ^{IS} firms. In Column (3), the coefficient on the silent R&D indicator is 0.0261, significant at the 1% level. This estimate implies that future profitability is about 2.6 percentage points higher for silent R&D firms in the high DQ^{IS} subsample. In Column (4), the coefficient on the interaction term is 0.1940, significant at the 10% level, meaning that silent R&D firms are more productive. The coefficient on the indicator for silent R&D firms is insignificant in specifications that include the interaction term, meaning that higher productivity of intangible investment explains the outperformance of silent R&D firms. In terms of magnitude, the outperformance of silent R&D firms is slightly higher in the low DQ^{IS} subsample. Overall, however, silent R&D firms have higher future profitability and higher intangible productivity regardless of the DQ^{IS}. Finally, the frequency of silent R&D firms is higher for low DQ^{IS} subsample (15.0%) that for high DQ^{IS} subsample (10.7%), given that missing R&D is a component of the DQ^{IS}. This result is not surprising given that missing R&D is input into the calculation of DQ^{IS}. Overall, however, the frequency of silent R&D firms is significant in both DQ^{IS} partitions.

Table A6 explores variation across partitions based on the balance-sheet DQ score (DQ^{BS}). I separate firms into the partitions of low and high DQ^{BS} based on industry-year median breakpoints. In Columns (1) and (2), I test the performance of silent R&D firms within the sample of low DQ^{BS} firms. In Column (1), the coefficient on the indicator for silent R&D firms is 0.0224, significant at the 1% level. This estimate implies that future profitability is about 2 percentage points higher for silent R&D firms in the low DQ subsample. In Column (2), the coefficient on the interaction term is 0.1718, significant at the 1% level, meaning that silent R&D firms are more productive. In Columns (3) and (4), I test the performance of silent R&D firms within the sample of high DQ^{BS} firms. In Column (3), the coefficient on silent R&D indicator is 0.0299, significant at the 1% level. This estimate implies that future profitability is about 3 percentage points higher for silent R&D firms in the high DQ^{BS} subsample. In Column (4), the coefficient on the interaction term is 0.3174, significant at the 1% level, meaning that silent R&D firms are more productive. The coefficient on the indicator for silent R&D firms is insignificant in specifications that include the interaction term, meaning that higher productivity of intangible investment explains the outperformance of silent R&D firms. Finally, the frequency of silent R&D firms is similar in both DQ^{BS} partitions.

In summary, I find that the silent R&D firms have higher future profitability and higher productivity of intangible investment across partitions formed on either the income-statement DQ score (DQ^{IS}) or balance-sheet DQ score (DQ^{BS}).

A3.7. Profitability accumulation horizon

My primary performance metric is future profitability accumulated over the next three years. In this section, I measure profitability at the alternative accumulation horizons and I show that my results are not sensitive to this choice.

In Table A7, I report profitability regressions using different horizon lengths. In Columns (1) and (2), I focus on the shorter, one-year-out horizon. In Column (1), the coefficient on the indicator for silent R&D firms is 0.0043, significant at the 1% level. This estimate implies that next-year profitability is 43 basis points higher for silent R&D firms. In Column (2), the coefficient on the interaction term is 0.0568, significant at the 1% level. This estimate means that incremental productivity in silent R&D firms is almost 6 cents from every dollar of intangible investment, such that silent R&D firms are more productive than non-silent R&D firms. In Columns (3) and (4), I present profitability regressions using baseline, three-year-out horizon. In Columns (5) and (6), I focus on the longer, five-year-out horizon. In Column (5), the coefficient on the indicator for silent R&D firms is 0.0591, significant at the 1% level. This estimate implies that next-year profitability is almost 6 percentage points higher for silent R&D firms. In Column (6), the coefficient on the interaction term is 0.5819, significant at the 1% level. This estimate means that the incremental productivity in silent R&D firms is 58 cents from every dollar of intangible investment, such that silent R&D firms are more productive than non-silent R&D firms. The coefficient on the indicator for silent R&D firms is insignificant in specifications that include the interaction term, meaning that higher productivity of intangible investment drives the incremental future profitability of silent R&D firms. Consistent with evidence in Figure 3, I also confirm that the profitability spread between silent and non-silent R&D firms increases in the accumulation period. The same is true for my measure of intangible productivity.

In summary, the results in Table A7 confirm that my findings are robust to the choice of the measurement horizon. Silent R&D firms have higher profitability and higher intangible productivity measured over one, three, and five-year-out horizons.

A3.8. Controlling for the scaling variable

I measure profitability and investment on a per-dollar-of-capital basis. In this section, I introduce an additional control variable for the inverse of capital to show that my results are not explained by the level of the scaling variable.

In Table A8, I report the results of profitability regressions after controlling for the inverse of capital. Column (1) shows the results from the profitability regression that includes an indicator for silent R&D firms, the inverse of capital variable, and the industry and year fixed effects. This specification corresponds to Model (1) in Table 3. In this specification, the coefficient on the indicator for silent R&D firms is 0.0516, significant at the 1% level. This estimate implies that future profitability, accumulated over the next three years, is 5.2 percentage points higher for silent R&D firms. This estimate is higher than the corresponding estimate in Table 3, Column (1). The coefficient on the inverse of capital is negative and statistically significant because scaled profitability decreases in the level of capital. Column (2) shows the results from the profitability regression that, apart from the inverse capital control variable, additionally includes intangible investment and interaction of intangible investment with the indicator for silent R&D firms. The coefficient on the interaction term between indicator for silent R&D firms and intangible investment is 0.4967, significant at the 1% level. This estimate is comparable to the corresponding estimate in Table 3, Column (2), and implies that silent R&D firms have higher productivity of intangible investment relative to non-silent R&D firms. The coefficient on the indicator for silent R&D firms is insignificant, meaning that the higher productivity of intangible investment explains the outperformance of silent R&D firms. In Columns (3) and (4), I repeat the tests after including the remaining control variables. In Column (3), the coefficient on the indicator for silent R&D firms is 0.0275, significant at the 1% level. This estimate implies that future profitability, accumulated over the next three years, is almost 3 percentage points higher for silent R&D firms. This estimate is comparable to the corresponding estimate in Table 3, Column (3). In Column (4), the coefficient on the interaction term between indicator for silent R&D firms and intangible investment is 0.2465, significant at the 1% level. This estimate is comparable to the corresponding estimate in Table 3, Column (4), and implies that silent R&D firms have higher productivity of intangible investment relative to non-silent R&D firms. Finally, the coefficient on the indicator for silent R&D firms is insignificant, meaning that higher productivity of intangible investment explains the outperformance of silent R&D firms. In all specifications, the coefficient on the inverse of capital variable remains negative and statistically significant.

In summary, the results in Table A8 confirm that my findings are not explained by the level of the scaling variable. Silent R&D firms have higher profitability and higher intangible productivity after controlling for the inverse of the capital used to scale profitability and investment variables.

A3.9. Alternative fixed effect estimators

In my empirical tests, I include industry fixed effects to control for industry-specific, time-invariant factors, and year fixed-effects to control for year-specific, firm-invariant factors. In this section, I examine alternative fixed-effect estimators and show that these alternative estimators produce results consistent with my main tests.

In Table A9, I report the results of profitability regressions after including industry-year fixed effects to control for industry-specific time trends. Column (1) shows the results from the profitability regression that only includes an indicator for silent R&D firms and the industry-year fixed effects. This specification corresponds to Model (1) in Table 3. In this specification, the coefficient on the indicator for silent R&D firms is 0.0430, significant at the 1% level. This estimate implies that future profitability, accumulated over the next three years, is 4.3 percentage points higher for silent R&D firms. This estimate is almost identical to the corresponding estimate in Table 3, Column (1). Column (2) shows the results from the profitability regression that additionally includes intangible investment and interaction of intangible investment with the indicator for silent R&D firms. The coefficient on the interaction term between indicator for silent R&D firms and intangible investment is 0.5140, significant at the 1% level. This estimate is comparable to the corresponding estimate in Table 3, Column (2), and implies that silent R&D firms have higher productivity of intangible investment relative to non-silent R&D firms. The coefficient on the indicator for silent R&D firms is insignificant, meaning that the higher productivity of intangible investment explains the outperformance of silent R&D firms. In Columns (3) and (4), I repeat the tests after including the remaining control variables. In Column (3), the coefficient on the indicator for silent R&D firms is 0.0268, significant at the 1% level. This estimate implies that future profitability, accumulated over the next three years, is almost 3 percentage points higher for silent R&D firms. This estimate is comparable to the corresponding estimate in Table 3, Column (3). In Column (4), the coefficient on the interaction term between indicator for silent R&D firms and intangible investment is 0.2480, significant at the 1% level. This estimate is comparable to the corresponding estimate in Table 3, Column (4), and implies that silent R&D firms have higher productivity of intangible investment relative to non-silent R&D firms. Finally, the coefficient on the indicator for silent R&D firms is insignificant, meaning that higher productivity of intangible investment explains the outperformance of silent R&D firms.

In Table A10, I report the results of profitability regressions after including firm fixed effects to control for firm-specific time-invariant factors. Column (1) shows the results from the profitability regression that only includes an indicator for silent R&D firms and firm and year fixed effects. This specification corresponds to Model (1) in Table 3. In this specification, the coefficient on the indicator for silent R&D firms is 0.0335, significant at the 10% level. This estimate implies that future profitability, accumulated over the next three years, is 3.3 percentage points higher for silent R&D firms. This estimate is lower, in terms of statistical and economic magnitude, than the corresponding estimate in Table 3, Column (1). This result is because most of the variation in silence is between (and not within) firms, and the inclusion of firm fixed effects effectively eliminates between-firm variation. Column (2) shows the results from the profitability regression that additionally includes intangible investment and interaction of intangible investment with the indicator for silent R&D firms. The coefficient on the interaction between the indicator for silent R&D firms and intangible investment is 0.2005, significant at the 1% level. This estimate is comparable to the corresponding estimate in Table 3, Column (2), and implies that silent R&D firms have higher productivity of intangible investment relative to non-silent R&D firms. The coefficient on the indicator for silent R&D firms is insignificant, meaning that the higher productivity of intangible investment explains the outperformance of silent R&D firms. The productivity result is largely robust to the inclusion of firm fixed effects because of the within-firm variation in the intangible investment. In Columns (3) and (4), I repeat the tests after including the additional control variables. In Column (3), the coefficient on the indicator for silent R&D firms is 0.0145. This estimate implies that future profitability, accumulated over the next three years, is 1.5 percentage points higher for silent R&D firms. The estimate is significant because most of the variation in silence is between (and not within) firms. In Column (4), the coefficient on the interaction term between indicator for silent R&D firms and intangible investment is 0.1994, significant at the 1% level. This estimate is comparable to the corresponding estimate in Table 3, Column (4), and implies that silent R&D firms have higher productivity of intangible investment relative to non-silent R&D firms. Finally, the coefficient on the indicator for silent R&D firms is insignificant, meaning that higher productivity of intangible investment explains the outperformance of silent R&D firms.

In summary, the results in Tables A9 and A10 confirm that the alternative fixed effect estimators produce results that are consistent with my main tests. In particular, I confirm that silent R&D firms have higher intangible productivity even after controlling for industry-specific time trends and firm-specific factors.

A3.10. Matching using the p-score method

In this section, I evaluate the performance of silent R&D firms relative to the sample matched using the propensity score ("p-score") method of Rosenbaum and Rubin (1983). I show that the incremental profitability of silent R&D firms relative to p-score-matched firms is consistent at around 2.5-3 percentage points as summarized in my main analysis. I also show that this higher profitability is driven by the higher productivity of their intangible capital.

I estimate the p-score using intangible investment, profitability, size, age, leverage, and Q as determinants of silence. I also add squared terms (Hirano et al. 2003) and industry and year fixed effects. The model explains 30% of the variation in silence, based on Nagelkerke's (1991) Pseudo-R2. In Figure A5, I report the density of p-score for silent R&D and p-score-matched firms, using kernel density estimation. The overlap of p-scores between the two samples is virtually perfect, meaning that there exist sufficient observations of non-silent R&D firms to provide matches for silent R&D firms.

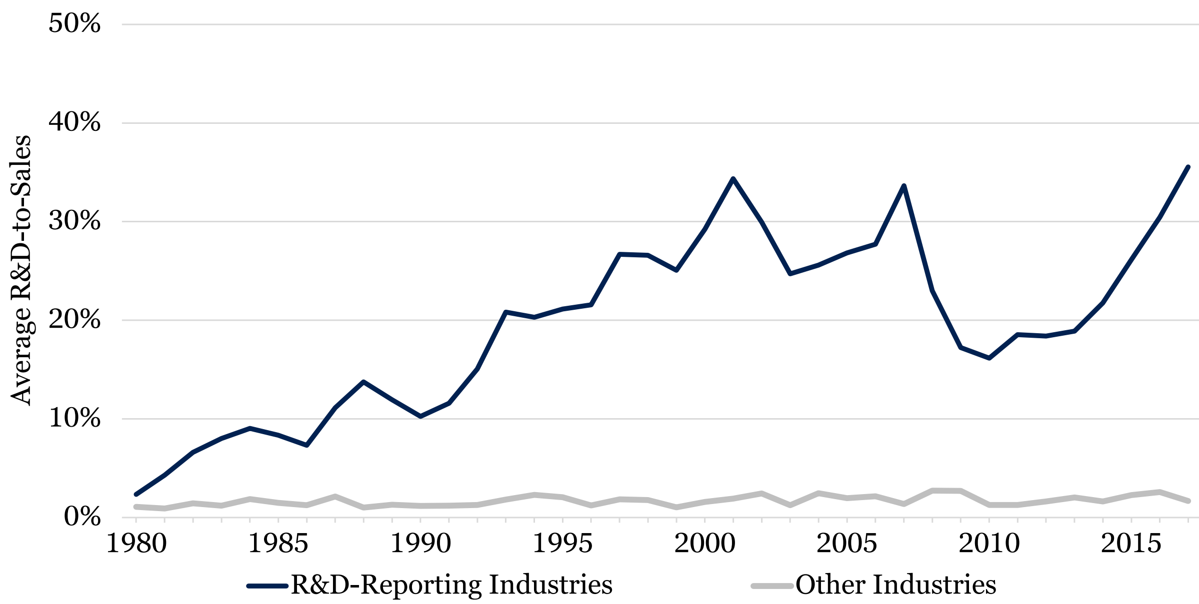
In Table A11, I report the two-sample comparison for silent and p-score-matched non-silent R&D firms. The average sales (operating profits) are 22 cents higher (virtually the same) for silent R&D firms in the current period, and 93 cents higher (2 cents higher) over three-periods-out horizon. The implied difference in future profitability is thus 2%. Consistent with cost pooling, the reported R&D is zero for silent R&D firms, whereas their SG&A expense is significantly higher than that of non-silent R&D firms. The total level of intangible investment is comparable between the two types of companies. Finally, the average silent R&D firm is younger and has higher leverage than the average p-score-matched firm. Except for the firm's age, the differences in means are smaller relative to differences between silent R&D and non-silent R&D firms reported in Table 1, Panel B. Given the high overlap in estimated p-scores, there is virtually no difference in mean p-scores between the two samples of firms.

In Figure A6, I present the abnormal performance of silent R&D firms relative to p-score-matched firms. The figure illustrates profitability in the current year ($t = 0$) and then accumulated over the next $H = 1, \dots, 5$ fiscal years, all relative to beginning-of-period capital at $t = 0$. Thus, the figure represents an average pattern of profitability evolution over the next five years. The profitability is presented relative to industry-year means. This adjustment helps to track the firm's performance relative to annual industry benchmarks. The evidence in Figure A6 is consistent with the outperformance of silent R&D firms: the industry-year-adjusted profitability of silent R&D firms is increasing from around 0% in the current period to about 3% over the five-periods-out horizon. In contrast, p-score-matched non-silent R&D firms underperform the industry-year benchmarks: the industry-year-adjusted profitability of non-silent R&D is decreasing from around 0% in the current period to almost −3% over the five-periods-out horizon. The combination of outperformance of silent R&D firms and the underperformance of non-silent R&D results in the spread in profitability between the two types of firms that increases with the length of the accumulation period.

In Table A12, I report the results of profitability regressions. Column (1) shows the results from the profitability regression that only includes indicator for silent R&D firms and industry and year fixed effects. In this specification, the coefficient on the indicator for silent R&D firms is 0.0233, but the estimate is statistically insignificant. In terms of economic magnitude, this estimate implies that future profitability, accumulated over the next three years, is 2.3 percentage points higher for silent R&D firms. This 2.3 percentage point difference is in line with the spread in Figure A6 at the same horizon. Column (2) shows the results from the profitability regression that additionally includes intangible investment and interaction of intangible investment with the indicator for silent R&D firms. The coefficient on the interaction between the indicator for silent R&D firms and intangible investment is 0.1695, but the estimate is statistically insignificant. In terms of economic magnitude, this estimate indicates that 1 dollar of intangible investment translates into additional 17 cents of three-year operating profit. In Columns (3) and (4), I repeat the tests after including control variables, which is doubly robust to errors in the specification of either the parametric model or the matching model (Ho et al. 2007). In Column (3), the coefficient on the indicator for silent R&D firms is 0.0287, significant at the 1% level, meaning that future profitability is almost 3 percentage points higher for silent R&D firms relative to comparable firms matched using p-score. In Column (4), the coefficient on the interaction term is 0.2584, significant at the 1% level, which implies that incremental productivity in silent R&D firms is 26 cents from every dollar of intangible investment. The coefficient on the indicator for silent R&D firms is insignificant, meaning that higher productivity of intangible investment explains the outperformance of silent R&D firms. The coefficient estimates differ in statistical significance and economic magnitude after the inclusion of control variables because the matching of silent R&D firms with comparable non-silent R&D firms is still imperfect.

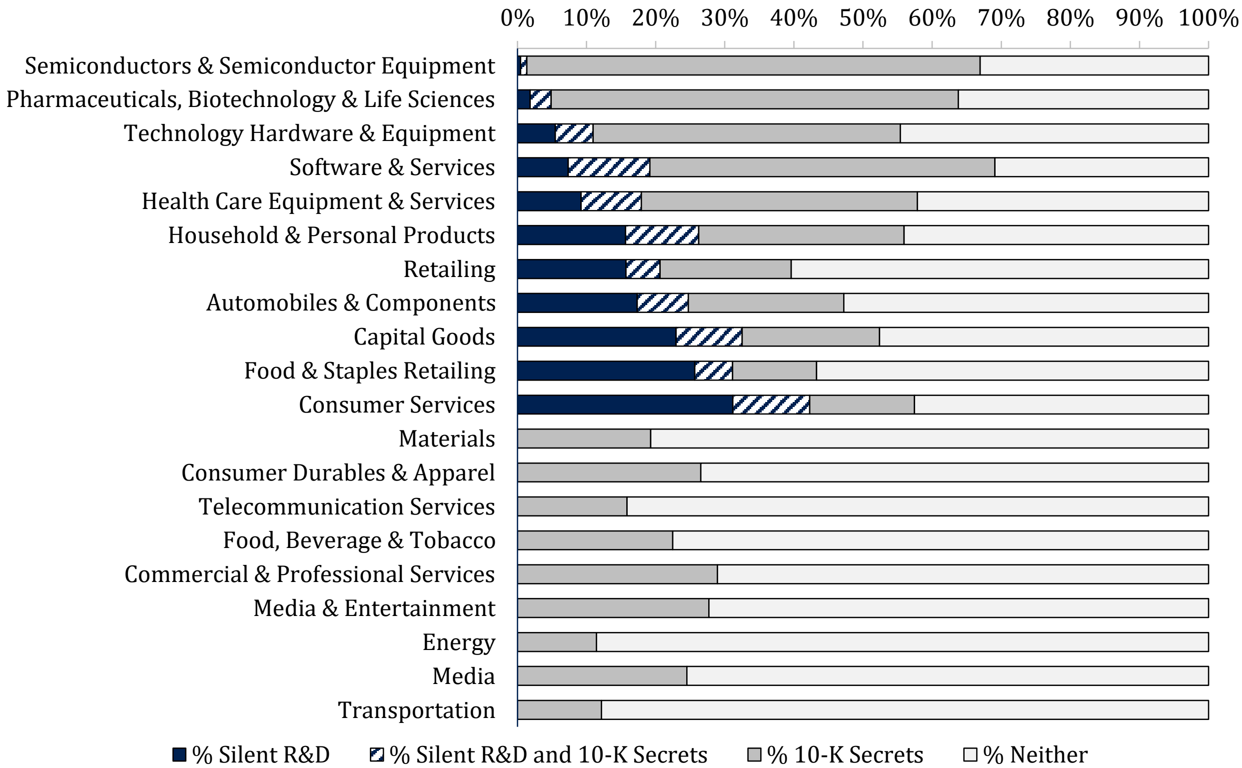
In summary, the results of this section show that silent R&D firms have higher future profitability and higher intangible productivity relative to comparable firms matched using the p-score matching method.

Figure A1
R&D-to-sales in R&D-reporting industries



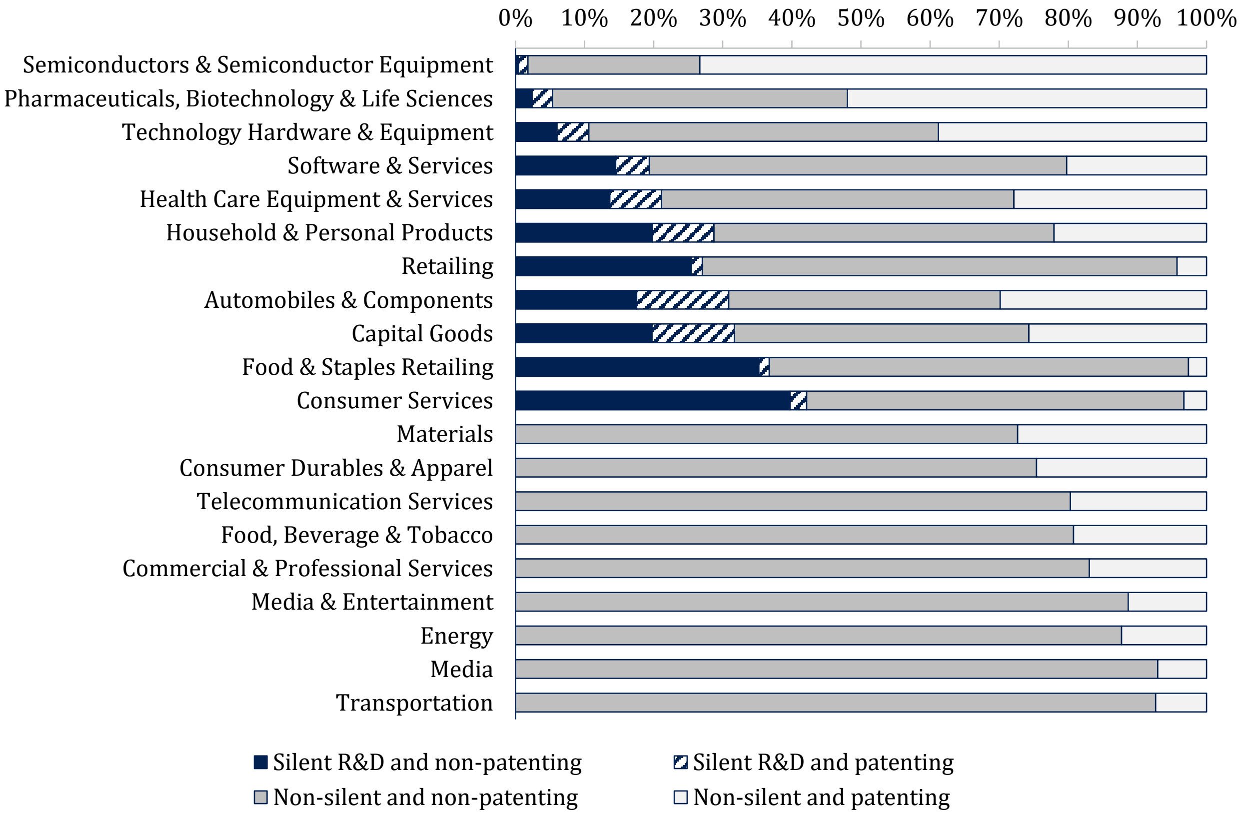
This figure presents the average R&D-to-sales ratio over time. The dark line shows the average R&D-to-sales ratio for firms in the R&D-reporting industries. R&D-reporting industries are industries where at least 50% of firm-year observations have non-missing R&D expense. The light line shows the average R&D-to-sales ratio in the remaining industries not classified as R&D-reporting. The sample includes 129,810 firm-year observations between 1980 and 2017.

Figure A2
Silent R&D and 10-K secrecy



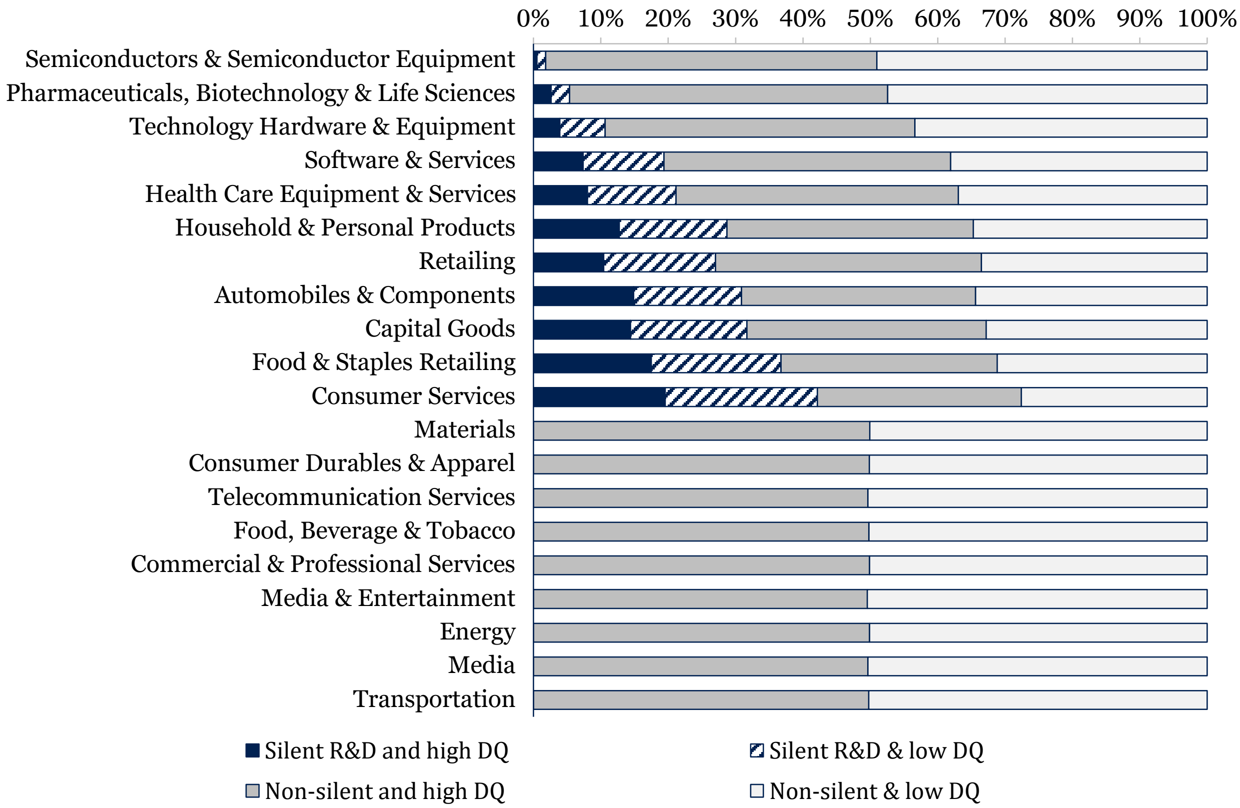
This figure shows the frequency of silent R&D and 10-K secrecy firms, including the overlap, by industry. 10-K secrecy firms are firms that mention trade secrets in their 10-K. The industry classification is based on GICS industry group membership. The sample includes 129,810 firm-year observations between 1980 and 2017.

Figure A3
Silent R&D and patenting



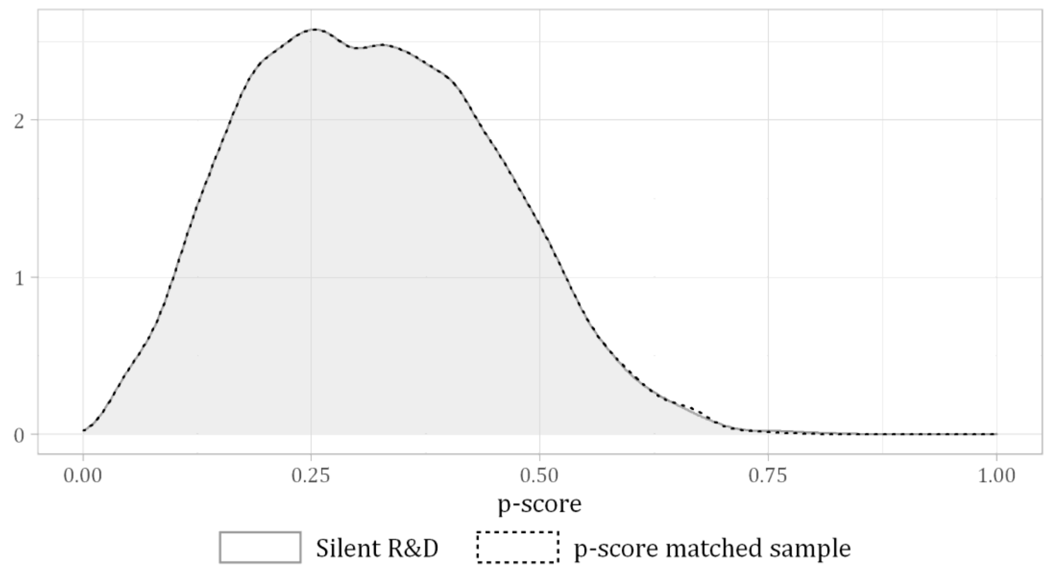
This figure shows patenting frequency in silent and non-silent R&D firms by industry. Patenting firms are firms filing for patents in a given year. The industry classification is based on GICS industry group membership. The sample includes 129,810 firm-year observations between 1980 and 2017.

Figure A4
Silent R&D and disclosure quality



This figure shows disclosure quality in silent and non-silent R&D firms by industry. The industry classification is based on GICS industry group membership. The disclosure quality is measured using the DQ measure of Chen et al. (2015). High (Low) DQ firms are firms with DQ scores above (below) the corresponding industry-year median breakpoint. The sample includes 129,810 firm-year observations between 1980 and 2017.

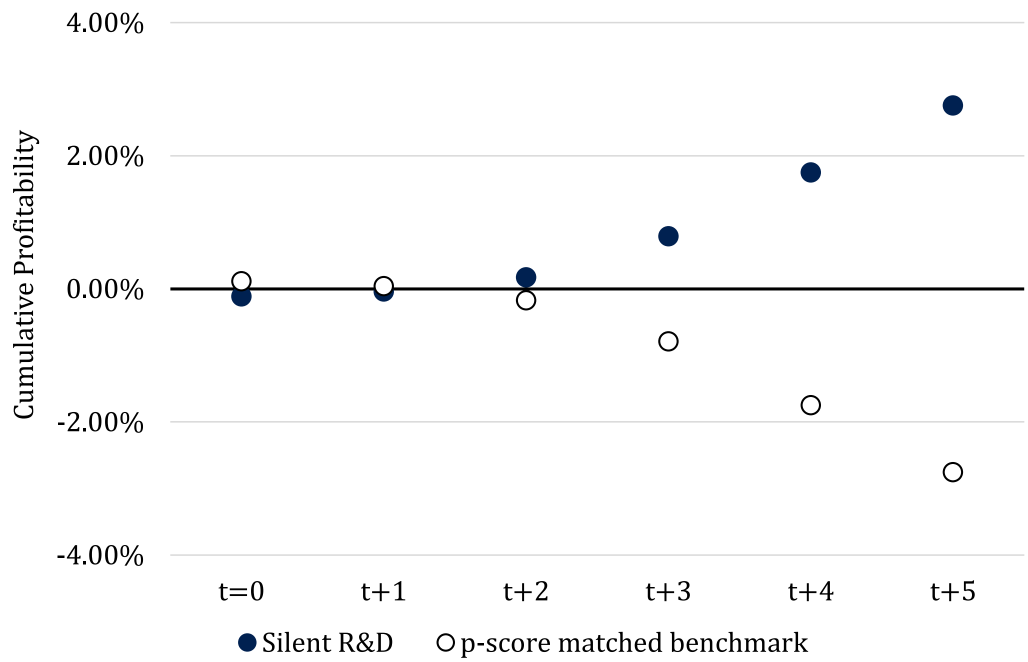
Figure A5
Overlap in p-scores between silent R&D and p-score-matched firms



This figure shows kernel density estimates of density functions of the p-scores for silent R&D firms (solid outline) and p-score-matched firms (dashed outline). I estimate the p-score using intangible investment, profitability, size, age, leverage, and Q, their squared terms, and industry and year fixed effects as determinants of silence. Firms are matched based on the estimated p-score using one-to-one matching with replacement. The p-score-matched sample of firms includes 33,532 firm-year observations between 1980 and 2017.

Figure A6

Abnormal performance of silent R&D firms: p-score-matched sample



This figure shows the abnormal performance of silent R&D (solid dots) and non-silent R&D (hollow dots) firms over time, using the p-score-matched sample. I estimate the p-score using intangible investment, profitability, size, age, leverage, and Q, their squared terms, and industry and year fixed effects as determinants of silence. Firms are matched based on the estimated p-score using one-to-one matching with replacement. Cumulative profitability is the operating income before intangible investment accumulated over the next t=1,...,5 years, per dollar of the beginning-of-period capital at t=0. Cumulative profitability is presented relative to industry-year means, calculated from the combined sample of silent R&D and p-score-matched firms. This combined sample includes 28,079 firm-year observations between 1980 and 2015 with non-missing data for at least five periods out.

Table A1

Productivity of intangible investment components in silent R&D firms

	Dependent Variable = $Profitability_{it+1,t+3}$					
	Intangible Investment		Balance Sheet Intangible Investment		R&D plus SG&A Investment	
	(1)	(2)	(3)	(4)	(5)	(6)
$I(Silent\ R\&D_{it})$	0.0274***	-0.0007	0.0241***	0.0213***	0.0204***	-0.0137
	(4.56)	(-0.09)	(4.19)	(3.75)	(3.30)	(-1.04)
$Investment_{it}$	0.0879**	0.0511	0.2679***	0.2471***	-0.2209***	-0.2590***
	(2.62)	(1.43)	(9.28)	(8.45)	(-3.31)	(-3.68)
$I(Silent\ R\&D_{it})$	.	0.2449***	.	0.1169**	.	0.3788***
$\times\ Investment_{it}$	.	(4.36)	.	(2.07)	.	(2.86)
$Profitability_{it}$	2.5934***	2.5918***	2.5884***	2.5882***	2.6194***	2.6169***
	(57.25)	(57.19)	(56.13)	(56.20)	(56.27)	(55.87)
$log(MV_{it-1})$	0.0097***	0.0096***	0.0091***	0.0091***	0.0087***	0.0086***
	(7.97)	(7.94)	(7.38)	(7.38)	(7.06)	(7.07)
$log(age_{it})$	0.0011	0.0013	0.0011	0.0011	-0.0011	-0.0009
	(0.33)	(0.38)	(0.31)	(0.33)	(-0.31)	(-0.25)
$Leverage_{it-1}$	-0.0187*	-0.0190*	-0.0269**	-0.0268**	-0.0437***	-0.0430***
	(-1.79)	(-1.81)	(-2.59)	(-2.58)	(-4.12)	(-4.06)
Q_{it-1}	0.0169***	0.0171***	0.0171***	0.0171***	0.0194***	0.0196***
	(5.10)	(5.17)	(5.07)	(5.07)	(5.84)	(5.93)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	48.3%	48.3%	48.4%	48.4%	48.3%	48.3%
N	129,810	129,810	129,810	129,810	129,810	129,810

This table examines the total investment productivity of silent R&D firms. Models (1) and (2) examine the productivity of the intangible investment, measured as a sum of the balance-sheet intangible investment and R&D plus SG&A investment. Models (3) and (4) examine the productivity of the balance sheet intangible investment measured as change in the balance sheet intangibles plus amortization per beginning-of-period capital. Models (5) and (6) examine the productivity of the off-balance sheet intangible investment measured as R&D plus a fraction of SG&A per beginning-of-period capital. All models include industry and year fixed effects to control for industry-specific and aggregate time-varying factors. The t-statistics (in parentheses) are based on standard errors clustered by firm and year. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively, based on two-tailed tests. The sample includes 129,810 firm-year observations between 1980 and 2017.

Table A2
M&A and joint venture activity of silent R&D firms

	$Dependent\ Variable\ =$		
	(1) $I(M\&A)$	(2) $I(Joint\ Venture)$	(3) $I(R\&D\ Agreement)$
$I(Silent\ R\&D_{it})$	0.2603***	-0.4610***	-1.0619***
	(3.23)	(-4.51)	(-6.18)
$IntInv_{it}$	6.9636***	1.4701***	2.0000***
	(14.78)	(8.67)	(5.97)
$Profitability_{it}$	0.8525***	-2.0020***	-1.8478***
	(3.43)	(-7.35)	(-4.40)
$log(MV_{it-1})$	0.2432***	0.5037***	0.5286***
	(8.03)	(21.58)	(18.77)
$log(age_{it})$	0.0850**	-0.1764***	-0.2126***
	(2.31)	(-4.88)	(-3.40)
$Leverage_{it-1}$	1.0398***	-0.2444*	-1.3954***
	(6.89)	(-1.86)	(-6.61)
Q_{it-1}	-0.1576***	-0.0585***	-0.1436***
	(-5.23)	(-2.70)	(-5.49)
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
R^2	14.0%	22.3%	30.4%
N	108,102	108,102	108,102

This table examines the M&A and joint venture activity of silent R&D firms. Silent R&D firms are firms with missing R&D that report SG&A and operate in industries where the majority of firms report R&D. The indicator of M&A activity, $I(M\&A)$, equals 1 if the firm engaged in any acquisition as with the deal value of at least $1 million and with post-transaction percent ownership of the target company of at least 50%, and 0 otherwise. The indicator of joint venture activity, $I(Joint\ Venture)$, equals 1 if the firm engages in any joint venture agreement classified as a strategic alliance, joint venture, or R&D agreement, and 0 otherwise. The indicator of R&D agreements, $I(R\&D\ Agreement)$, equals 1 if the firm engaged in any joint venture agreement classified explicitly as an R&D agreement, and 0 otherwise. The models include industry and year fixed effects to control for industry-specific and aggregate time-varying factors. All models are estimated using logistic regression. The t-statistics (in parentheses) are based on standard errors clustered by firm and year. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively, based on two-tailed tests. I use SDC data to obtain information on M&A and joint venture activity. The sample includes 108,102 firm-year observations between 1980 and 2017 with matching SDC data.

Table A3

M&A investment productivity of silent R&D firms

	$Dependent\ Variable\ =\ Profitability_{it+1,t+3}$			
	(1)	(2)	(3)	(4)
$I(Silent\ R\&D_{it})$	0.0450***	0.0323**	0.0257***	0.0216***
	(3.50)	(2.54)	(4.42)	(3.56)
$M\&AInv_{it}$	.	0.0837	0.0268	0.0203
	.	(1.59)	(1.48)	(1.29)
$I(Silent\ R\&D_{it}) \times M\&AInv_{it}$	.	0.4630***	.	0.1537***
	.	(6.98)	.	(4.63)
$Profitability_{it}$	.	.	0.0095***	0.0094***
	.	.	(7.67)	(7.68)
$log(MV_{it-1})$	.	.	0.0003	0.0003
	.	.	(0.10)	(0.09)
$log(age_{it})$	.	.	-0.0257**	-0.0257**
	.	.	(-2.45)	(-2.46)
$Leverage_{it-1}$	.	.	2.6032***	2.6017***
	.	.	(56.83)	(56.88)
Q_{it-1}	.	.	0.0176***	0.0175***
	.	.	(5.26)	(5.22)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	3.1%	3.5%	48.3%	48.3%
N	129,810	129,810	129,810	129,810

This table examines the M&A investment productivity of silent R&D firms. Silent R&D firms are firms with missing R&D that report SG&A and operate in industries where the majority of firms report R&D. The M&A productivity is measured as a coefficient on M&A investment in the regression of future profitability. I measure M&A investment as the dollar value of acquisition deals reported in SDC data, per dollar of beginning-of-period capital. I set missing observations of M&A investment to zero. The models include industry and year fixed effects to control for industry-specific and aggregate time-varying factors. The t-statistics (in parentheses) are based on standard errors clustered by firm and year. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively, based on two-tailed tests. The sample includes 129,810 firm-year observations between 1980 and 2017.

Table A4

Alternative definitions of secrecy

	Dependent Variable = $Profitability_{it+1,t+H}$					
$I(Z_{it})$ =	$I(Silent\ R\&D_{it})$		$I(10\text{-}K\ Secrecy_{it})$		$I(Pseudo\ R\&D_{it})$	
	(1)	(2)	(3)	(4)	(5)	(6)
$I(Z_{it})$	0.0274***	-0.0007	-0.0052	0.0011	0.0038	-0.0104
	(4.56)	(-0.09)	(-1.17)	(0.21)	(0.52)	(-1.23)
$IntInv_{it}$	0.0879**	0.0511	0.0590	0.0792*	0.0829**	0.0786**
	(2.62)	(1.43)	(1.58)	(1.93)	(2.51)	(2.34)
$I(Z_{it}) \times IntInv_{it}$	.	0.2449***	.	-0.0482	.	0.1702*
	.	(4.36)	.	(-1.19)	.	(1.76)
$Profitability_{it}$	2.5934***	2.5918***	2.5478***	2.5475***	2.5979***	2.5976***
	(57.25)	(57.19)	(40.01)	(40.04)	(56.90)	(56.90)
$log(MV_{it-1})$	0.0097***	0.0096***	0.0095***	0.0095***	0.0092***	0.0092***
	(7.97)	(7.94)	(6.61)	(6.66)	(7.44)	(7.45)
$log(age_{it})$	0.0011	0.0013	0.0062	0.0061	0.0011	0.0011
	(0.33)	(0.38)	(1.55)	(1.52)	(0.31)	(0.32)
$Leverage_{it-1}$	-0.0187*	-0.0190*	-0.0027	-0.0025	-0.0143	-0.0143
	(-1.79)	(-1.81)	(-0.20)	(-0.19)	(-1.35)	(-1.35)
Q_{it-1}	0.0169***	0.0171***	0.0212***	0.0213***	0.0170***	0.0170***
	(5.10)	(5.17)	(5.11)	(5.13)	(5.13)	(5.13)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	48.3%	48.3%	49.4%	49.4%	48.3%	48.3%
N	129,810	129,810	81,740	81,740	129,810	129,810

This table examines the intangible productivity of silent R&D firms using three alternative definitions of secrecy. Columns (1) and (2) are baseline results using Silent R&D firms. Columns (3) and (4) are results using 10-K secrecy firms. 10-K secrecy firms are firms mentioning trade secrets or trade secrecy in their 10-K. Columns (5) and (6) are results using pseudo-R&D firms of Koh and Reeb (2015). Pseudo-R&D firms are missing R&D firms with patenting activity. All models include industry and year fixed effects to control for industry-specific and aggregate time-varying factors. The t-statistics (in parentheses) are based on standard errors clustered by firm and year. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively, based on two-tailed tests. The main sample includes 129,810 observations between 1980 and 2017. The sample for 10-K secrecy firms includes 81,740 firm-year observations between 1995 and 2017. This sample starts in 1995 when EDGAR index files were first available.

Table A5

Silent R&D and income statement disclosure quality

	$Dependent\ Variable\ =\ Profitability_{it+1,t+3}$			
	Low DQ^{IS} firms		High DQ^{IS} firms	
	(1)	(2)	(3)	(4)
$I(Silent\ R\&D_{it})$	0.0309***	-0.0033	0.0261***	0.0043
	(4.12)	(-0.37)	(3.06)	(0.34)
$IntInv_{it}$	0.0989***	0.0464	0.0805*	0.0575
	(3.02)	(1.39)	(1.96)	(1.26)
$I(Silent\ R\&D_{it}) \times IntInv_{it}$	.	0.2950***	.	0.1940*
	.	(4.29)	.	(2.02)
$Profitability_{it}$	2.5402***	2.5373***	2.6391***	2.6379***
	(53.73)	(53.83)	(55.05)	(54.89)
$log(MV_{it-1})$	0.0101***	0.0100***	0.0097***	0.0097***
	(7.56)	(7.50)	(6.33)	(6.33)
$log(age_{it})$	-0.0024	-0.0022	0.0048	0.0050
	(-0.63)	(-0.59)	(1.07)	(1.10)
$Leverage_{it-1}$	-0.0031	-0.0034	-0.0286**	-0.0287**
	(-0.23)	(-0.26)	(-2.14)	(-2.14)
Q_{it-1}	0.0119***	0.0121***	0.0199***	0.0201***
	(3.05)	(3.11)	(5.26)	(5.32)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	46.5%	46.6%	49.1%	49.1%
N	66,199	66,199	63,611	63,611
% Silent R&D	15.0%	15.0%	10.7%	10.7%

This table examines the intangible productivity of silent R&D firms across partitions based on the quality of income statement disclosure. The income statement disclosure quality is measured using the income statement component of the DQ measure of Chen et al. (2015). High (low) DQ^{IS} firms have income statement DQ above (below) industry-year median breakpoints. Columns (1) and (2) show results for the sample of firms with low DQ^{IS}. Columns (3) and (4) show results for the sample of firms with high DQ. All models include industry and year fixed effects to control for industry-specific and aggregate time-varying factors. The t-statistics (in parentheses) are based on standard errors clustered by firm and year. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively, based on two-tailed tests. The sample includes 129,810 firm-year observations between 1980 and 2017.

Table A6

Silent R&D and balance sheet disclosure quality

	$Dependent\ Variable\ =\ Profitability_{it+1,t+3}$			
	Low DQ^{BS} firms		High DQ^{BS} firms	
	(1)	(2)	(3)	(4)
$I(Silent\ R\&D_{it})$	0.0224***	0.0022	0.0299***	-0.0054
	(2.91)	(0.23)	(3.34)	(-0.48)
$IntInv_{it}$	0.1382***	0.1087**	0.0340	-0.0071
	(3.47)	(2.60)	(0.85)	(-0.17)
$I(Silent\ R\&D_{it}) \times IntInv_{it}$	.	0.1718***	.	0.3174***
	.	(2.72)	.	(3.66)
$Profitability_{it}$	2.5930***	2.5918***	2.5713***	2.5693***
	(45.25)	(45.22)	(61.01)	(60.90)
$log(MV_{it-1})$	0.0092***	0.0092***	0.0107***	0.0107***
	(5.60)	(5.58)	(7.43)	(7.41)
$log(age_{it})$	-0.0013	-0.0012	0.0014	0.0016
	(-0.31)	(-0.29)	(0.32)	(0.38)
$Leverage_{it-1}$	-0.0110	-0.0111	-0.0241*	-0.0242*
	(-0.80)	(-0.82)	(-1.91)	(-1.92)
Q_{it-1}	0.0243***	0.0244***	0.0107***	0.0109***
	(5.40)	(5.43)	(2.86)	(2.93)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	49.0%	49.0%	47.6%	47.6%
N	65,105	65,105	64,705	64,705
% Silent R&D	13.5%	13.5%	12.4%	12.4%

This table examines the intangible productivity of silent R&D firms across partitions based on the quality of balance sheet disclosure. The disclosure quality is measured using the balance sheet component of the DQ measure of Chen et al. (2015). High (low) DQ^{BS} firms have balance sheet DQ above (below) industry-year median breakpoints. Columns (1) and (2) show results for the sample of firms with low DQ^{BS}. Columns (3) and (4) show results for the sample of firms with high DQ. All models include industry and year fixed effects to control for industry-specific and aggregate time-varying factors. The t-statistics (in parentheses) are based on standard errors clustered by firm and year. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively, based on two-tailed tests. The sample includes 129,810 firm-year observations between 1980 and 2017.

Table A7

Alternative profitability accumulation horizon

	$Dependent\ Variable\ =\ Profitability_{it+1,t+H}$					
	$H = 1$		$H = 3$		$H = 5$	
	(1)	(2)	(3)	(4)	(5)	(6)
$I(Silent\ R\&D_{it})$	0.0043***	-0.0022	0.0274***	-0.0007	0.0591***	-0.0069
	(4.65)	(-1.56)	(4.56)	(-0.09)	(3.22)	(-0.30)
$IntInv_{it}$	0.0295***	0.0210**	0.0879**	0.0511	0.2031**	0.1156
	(3.30)	(2.26)	(2.62)	(1.43)	(2.39)	(1.24)
$I(Silent\ R\&D_{it}) \times IntInv_{it}$	.	0.0568***	.	0.2449***	.	0.5819***
	.	(4.79)	.	(4.36)	.	(3.41)
$Profitability_{it}$	0.9179***	0.9175***	2.5934***	2.5918***	4.3941***	4.3904***
	(73.29)	(73.11)	(57.25)	(57.19)	(42.98)	(42.94)
$log(MV_{it-1})$	0.0017***	0.0017***	0.0097***	0.0096***	0.0162***	0.0160***
	(5.81)	(5.77)	(7.97)	(7.94)	(5.49)	(5.44)
$log(age_{it})$	0.0006	0.0006	0.0011	0.0013	-0.0165	-0.0161
	(0.70)	(0.75)	(0.33)	(0.38)	(-1.68)	(-1.65)
$Leverage_{it-1}$	-0.0018	-0.0018	-0.0187*	-0.0190*	-0.0230	-0.0239
	(-0.74)	(-0.77)	(-1.79)	(-1.81)	(-0.82)	(-0.85)
Q_{it-1}	0.0029***	0.0030***	0.0169***	0.0171***	0.0393***	0.0396***
	(3.81)	(3.87)	(5.10)	(5.17)	(4.71)	(4.77)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	58.5%	58.5%	48.3%	48.3%	29.8%	29.9%
N	129,810	129,810	129,810	129,810	108,266	108,266

This table examines the intangible productivity of silent R&D firms using three different profitability accumulation periods. Columns (1) and (2) are results using a shorter one-year-out horizon, such that profitability is measured over the next year. Columns (3) and (4) are baseline results using three-years-out horizon. Columns (5) and (6) are results using a longer five-year-out horizon, such that profitability is measured over the next five years. All models include industry and year fixed effects to control for industry-specific and aggregate time-varying factors. The t-statistics (in parentheses) are based on standard errors clustered by firm and year. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively, based on two-tailed tests. The main sample includes 129,810 observations between 1980 and 2017.

Table A8

Intangible productivity after controlling for inverse of capital

	Dependent Variable = $Profitability_{it+1,t+3}$			
	(1)	(2)	(3)	(4)
$I(Silent\ R\&D_{it})$	0.0516***	0.0118	0.0275***	-0.0007
	(4.01)	(0.81)	(4.59)	(-0.09)
$IntInv_{it}$	.	0.7665***	0.0883**	0.0512
	.	(11.33)	(2.63)	(1.44)
$I(Silent\ R\&D_{it}) \times IntInv_{it}$	.	0.4967***	.	0.2465***
	.	(6.05)	.	(4.39)
$1/K_{it-1}$	-0.8297***	-0.8607***	-0.0702**	-0.0713**
	(-7.32)	(-7.27)	(-2.41)	(-2.44)
$Profitability_{it}$	.	.	0.0085***	0.0084***
	.	.	(6.92)	(6.86)
$log(MV_{it-1})$	.	.	0.0009	0.0010
	.	.	(0.25)	(0.30)
$log(age_{it})$	.	.	-0.0202*	-0.0206*
	.	.	(-1.92)	(-1.95)
$Leverage_{it-1}$	.	.	2.5889***	2.5871***
	.	.	(56.73)	(56.68)
Q_{it-1}	.	.	0.0183***	0.0185***
	.	.	(5.47)	(5.54)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	5.1%	7.3%	48.3%	48.3%
N	129,810	129,810	129,810	129,810

This table examines the intangible productivity of silent R&D firms after controlling for the inverse of capital. The additional control variable is an inverse of the scaling variable used to measure profitability, investment, leverage, and Q. The models include industry and year fixed effects to control for industry-specific and aggregate time-varying factors. The t-statistics (in parentheses) are based on standard errors clustered by firm and year. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively, based on two-tailed tests. The sample includes 129,810 firm-year observations between 1980 and 2017.

Table A9

Intangible productivity of silent R&D firms with industry-year fixed effects

	$Dependent\ Variable\ =\ Profitability_{it+1,t+3}$			
	(1)	(2)	(3)	(4)
$I(Silent\ R\&D_{it})$	0.0430***	0.0004	0.0268***	-0.0017
	(3.36)	(0.03)	(4.45)	(-0.22)
$IntInv_{it}$	.	0.7302***	0.0936***	0.0562
	.	(11.17)	(2.96)	(1.67)
$I(Silent\ R\&D_{it}) \times IntInv_{it}$	.	0.5140***	.	0.2480***
	.	(6.33)	.	(4.54)
$Profitability_{it}$	.	.	2.5868***	2.5851***
	.	.	(61.01)	(60.96)
$log(MV_{it-1})$	.	.	0.0108***	0.0107***
	.	.	(9.62)	(9.59)
$log(age_{it})$	.	.	-0.0007	-0.0005
	.	.	(-0.22)	(-0.17)
$Leverage_{it-1}$	.	.	-0.0221**	-0.0223**
	.	.	(-2.14)	(-2.16)
Q_{it-1}	.	.	0.0200***	0.0202***
	.	.	(6.76)	(6.84)
Industry x Year FE	Yes	Yes	Yes	Yes
R^2	5.8%	7.9%	50.0%	50.0%
N	129,810	129,810	129,810	129,810

This table examines the intangible productivity of silent R&D firms after controlling for industry-year fixed effects to control for industry-specific time trends. The t-statistics (in parentheses) are based on standard errors clustered by firm and year. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively, based on two-tailed tests. The sample includes 129,810 firm-year observations between 1980 and 2017.

Table A10

Intangible productivity of silent R&D firms with firm fixed effects

	$Dependent\ Variable\ =\ Profitability_{it+1,t+3}$			
	(1)	(2)	(3)	(4)
$I(Silent\ R\&D_{it})$	0.0335*	0.0140	0.0145	-0.0078
	(2.02)	(0.83)	(1.16)	(-0.59)
$IntInv_{it}$	.	0.7055***	0.1654***	0.1342***
	.	(13.42)	(6.05)	(4.63)
$I(Silent\ R\&D_{it}) \times IntInv_{it}$	.	0.2005***	.	0.1994***
	.	(3.20)	.	(3.76)
$Profitability_{it}$	.	.	1.6581***	1.6577***
	.	.	(37.09)	(37.07)
$log(MV_{it-1})$	.	.	-0.1182***	-0.1182***
	.	.	(-19.79)	(-19.81)
$log(age_{it})$	.	.	-0.0359***	-0.0360***
	.	.	(-3.58)	(-3.58)
$Leverage_{it-1}$	.	.	-0.1611***	-0.1610***
	.	.	(-8.47)	(-8.46)
Q_{it-1}	.	.	0.0763***	0.0764***
	.	.	(14.57)	(14.60)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	52.0%	53.2%	63.7%	63.7%
N	129,810	129,810	129,810	129,810

This table examines the intangible productivity of silent R&D firms after controlling for firm and year fixed effects to control for firm-specific and aggregate time-varying factors. The t-statistics (in parentheses) are based on standard errors clustered by firm and year. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively, based on two-tailed tests. The sample includes 129,810 firm-year observations between 1980 and 2017.

Table A11
Sample differences: p-score-matched sample

	$I(Silent\ R\&D_{it}) = 1$		$I(Silent\ R\&D_{it}) = 0$		Comparison	
	Mean	Sd.	Mean	Sd.	Diff.	t-stat
$Sales_{it}$	1.528	0.935	1.305	0.848	0.222***	22.790
$Sales_{it+1,t+3}$	5.684	4.200	4.751	3.619	0.933***	21.798
$Profitability_{it}$	0.115	0.137	0.117	0.135	-0.002	-1.492
$Profitability_{it+1,t+3}$	0.425	0.560	0.404	0.538	0.022***	3.608
$R\&D_{it}$	0.000	0.000	0.028	0.044	-0.028***	-83.579
$SG\&A_{it}$	0.288	0.195	0.245	0.169	0.043***	21.758
$IntInv_{it}$	0.110	0.109	0.113	0.104	-0.003**	-2.407
$log(MV_{it-1})$	4.522	2.293	4.562	2.283	-0.040	-1.602
$log(age_{it})$	2.834	0.856	2.853	0.853	-0.019**	-2.048
$Leverage_{it-1}$	0.243	0.195	0.236	0.188	0.008***	3.748
Q_{it-1}	1.324	1.121	1.328	1.125	-0.004	-0.357
$p\text{-}score$	0.317	0.137	0.317	0.136	0.000	0.100

This table compares means for silent R&D and non-silent R&D firms using the p-score-matched sample. I estimate the p-score using intangible investment, profitability, size, age, leverage, and Q, their squared terms, and industry and year fixed effects as determinants of silence. Firms are matched based on the estimated p-score using one-to-one matching with replacement. The p-scored matched sample of firms includes 33,532 firm-year observations between 1980 and 2017.

Table A12

Intangible productivity of silent R&D firms: p-score-matched sample

	Dependent Variable = $Profitability_{it+1,t+3}$			
	(1)	(2)	(3)	(4)
$I(Silent\ R\&D_{it})$	0.0233	0.0075	0.0287***	-0.0003
	(1.67)	(0.51)	(3.94)	(-0.03)
$IntInv_{it}$	.	1.0669***	0.1455**	0.0072
	.	(9.66)	(2.62)	(0.09)
$I(Silent\ R\&D_{it}) \times IntInv_{it}$	.	0.1695	.	0.2584***
	.	(1.61)	.	(3.05)
$Profitability_{it}$	.	.	2.6058***	2.6083***
	.	.	(49.79)	(49.71)
$log(MV_{it-1})$	.	.	0.0108***	0.0106***
	.	.	(5.98)	(5.92)
$log(age_{it})$	.	.	-0.0064	-0.0062
	.	.	(-1.31)	(-1.27)
$Leverage_{it-1}$	.	.	-0.0621***	-0.0629***
	.	.	(-3.32)	(-3.37)
Q_{it-1}	.	.	0.0237***	0.0237***
	.	.	(4.19)	(4.22)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	2.1%	6.8%	48.1%	48.1%
N	33,532	33,532	33,532	33,532

This table examines the intangible productivity of silent R&D firms using the p-score-matched sample. I estimate the p-score using intangible investment, profitability, size, age, leverage, and Q, their squared terms, and industry and year fixed effects as determinants of silence. Firms are matched based on the estimated p-score using one-to-one matching with replacement. The profitability models include industry and year fixed effects to control for industry-specific and aggregate time-varying factors. The t-statistics (in parentheses) are based on standard errors clustered by firm and year. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively, based on two-tailed tests. The p-scored matched sample of firms includes 33,532 firm-year observations between 1980 and 2017.