

Inventor Performance Pressure and Opportunistic Innovation Management

Abstract

We investigate whether corporate inventors, incentivized by annual performance appraisals, engage in opportunistic innovation management by filing an excessive number of low-quality patents. Using data on U.S. public firms, we document a 43% surge in patent filings during fiscal year-end months compared to other months, with these additional patents exhibiting significantly lower quality. Innovation management is more pronounced among inventors facing greater performance pressure. While this behavior initially reduces inventor turnover, it increases inventor turnover in later years, reflecting a tradeoff between short-term performance gains and long-term reputational costs. Innovation management also declines significantly following the abandonment of annual performance appraisals. At the firm level, it is associated with lower future firm performance and stock returns.

Keywords: Nonfinancial performance metrics, innovation management, inventor opportunistic behavior, patent quality, annual performance appraisals.

JEL Classification: G34, M46, J24, O31

A central role of accounting is to design performance measurement systems that motivate productive behavior and mitigate agency problems. However, a large body of research has shown that conventional performance measures can distort financial metrics, such as accrual-based earnings management (Jones 1991; Dechow, Sloan, and Sweeney 1995) and real activities manipulation (Roychowdhury 2006). While the existing literature provides extensive evidence on how performance measurement distorts financial metrics and managerial behavior, far less is known about its impact on *nonfinancial performance metrics* and the behavioral responses of *non-executive employees*. This gap has become increasingly salient with the rising importance of intangible assets, skilled labor, and the widespread adoption of nonfinancial indicators. In this paper, we attempt to address this gap by examining whether performance appraisal systems induce opportunistic behavior among corporate inventors, leading to distortions in patent output, a key nonfinancial performance metric.

Like all employees, inventors face performance appraisal pressures. In the U.S., most firms conduct annual performance reviews to assess compensation, promotions, and retention. Critically, these reviews are typically synchronized with fiscal year-end (FYE) cycles. To illustrate this dynamic, Figure 1 presents employee testimonies from Google (Panel A) and Microsoft (Panel B), sourced from Quora. These testimonies demonstrate that it is common for firms to schedule performance reviews at the FYE, evaluating employees based on their ability to meet or exceed predefined objectives. For inventors specifically, the number of patent applications filed is a crucial metric in their performance evaluations (see Section 1).

We examine whether performance pressure from annual appraisals prompts inventors to file an excessive number of low-quality patents to boost short-term performance metrics. If present, such behavior should intensify near evaluation deadlines, particularly during FYE periods. We

refer to this behavior as “innovation management”. Innovation management is analogous to the well-documented earnings management (e.g., Healy 1985), in which managers manipulate reported quarterly or annual earnings to enhance short-term accounting performance. In contrast, innovation management represents a parallel form of distortion within the domain of corporate innovation and nonfinancial metrics.¹

The existence of innovation management is theoretically ambiguous. On the one hand, patent filing counts are often prioritized in performance reviews, as quantity is more readily observable than quality (which requires specialized expertise and involves significant time lags). Consequently, inventors might be inclined to engage in innovation management. On the other hand, however, countervailing forces could suppress innovation management. Inventors may avoid short-term gaming due to career concerns about long-term professional credibility. Additionally, corporate monitoring mechanisms (e.g., patent review committees) could mitigate or even prevent strategic innovation management.

Using data on all patents filed by US publicly listed firms from 1980 to 2019, we first document stylized facts on the seasonality of corporate patent filings. We find an apparent surge in filings during December compared to other months. Importantly, this spike is observed exclusively among firms with December fiscal year-ends and is completely absent in firms with non-December fiscal year-ends. This distinction leads to a broader analysis of FYE patent filings across the full sample. We find that public firms file 262,719 patents during their respective FYE months, compared to an average of 183,589 patents in non-FYE months, a 43.1% increase. This systematic pattern provides compelling evidence consistent with innovation management behavior

¹ Similar behavior has been documented for asset managers who engage in portfolio pumping or window dressing at quarter- and year-ends to showcase their skills and attract fund inflows (e.g., Lakonishok 1991; Chevalier and Ellison 1997; Musto 1999; Carhart et al. 2002; Ben-David et al. 2013).

ted to annual performance appraisal cycles.²

For comparison, we examine patent filings by individual inventors and find no similar surge in year-end filings, suggesting that the observed spike in FYE patent filings is a corporate phenomenon. Further analyses show that innovation management persists over time and is pervasive across firms of varying sizes, industries, and technology classes. Moreover, innovation management is not limited to U.S. firms. For example, Chinese public firms, which uniformly operate on a December fiscal year-end, exhibit a 120% increase in December patent filings compared to other months. This seasonality remains robust in formal OLS and Poisson regressions that control for firm characteristics and include firm and year fixed effects.

It is important to note that not all patent filings during the FYE months (i.e., “FYE patents”) are necessarily driven by opportunistic innovation management. To more accurately identify opportunistic behavior, we classify FYE patents into two groups: those associated with innovation management (“*IM Patents*”), and those not associated (“non-IM patents”), based on inventors’ individual filing tendencies. Specifically, if an inventor exhibits an abnormally high propensity to file patents during the FYE month in a given year, those FYE patents are more likely to reflect opportunistic timing and are classified as *IM patents*. The remaining FYE patents are classified as non-IM patents. Under the innovation management hypothesis, we expect IM patents, more so than FYE patents in general, to exhibit significantly lower quality than other patents.

We follow the literature and construct five measures of patent quality: forward citations, truncation-adjusted citations (Hall, Jaffe, and Trajtenberg 2001, 2005), patent originality (Hsu, Tian, and Xu 2014), a no-citation indicator (Balsmeier, Fleming and Manso 2017), and a breakthrough-patent indicator (Singh and Fleming 2010). We estimate patent-level regressions of

² This spike is not limited to December fiscal year ends, as it also occurs in non-December fiscal year ends.

these quality measures, controlling for firm, art unit, and filing year fixed effects. The results show that FYE patents exhibit significantly lower quality than patents filed during non-FYE months across all five metrics. Further analyses reveal that the decline in patent quality is concentrated among IM patents rather than non-IM patents. Specifically, IM patents exhibit quality measures that are 7% to 10% lower compared to other patents. To complement the analysis of patent quality, we follow the literature and examine patent disclosure quality (Dyer et al. 2024). We find that IM patents are associated with significantly weaker disclosure quality: they feature shorter description sections, lower textual readability, fewer figures and sheets, and fewer claims (indicating narrower protection) compared to their peers.

We next examine the incentives driving innovation management and its consequences for inventors. On the incentives side, we hypothesize that inventors who are trailing in patent filings earlier in the year are more likely to engage in innovation management.³ Moreover, inventors with less experience or weaker historical performance may face greater scrutiny during performance appraisals, increasing their innovation management propensity. Consistent with these conjectures, we find that innovation management is significantly more prevalent among inventors who are trailing in patent filings earlier in the year, have less experience, and exhibit weaker track records. On the consequence side, we find that innovation management is associated with a significantly lower likelihood of inventor turnover in the next four years, suggesting short-term retention benefits. However, in subsequent years, these inventors experience a significantly higher likelihood of turnover, consistent with reputational costs and the long-run consequences of lower-quality innovation output.

To directly examine the link between innovation management and annual performance

³ This pattern is analogous to the well-documented tournament behavior of mutual fund managers, where mid-year losers tend to increase portfolio risk during the second half of the year (e.g., Brown, Harlow, and Starks, 1996).

appraisals, we analyze firms that have publicly abandoned the practice of annual reviews. We begin by examining four such cases identified through news reports and find that, in each case, innovation management declines significantly after the abandonment. In contrast, matched peer firms that retain annual appraisals exhibit no comparable change in innovation management. To expand the analysis, we conduct a comprehensive manual search across S&P 500 firms and identify fourteen companies that announced the discontinuation of annual performance appraisals during our sample period. Using this broader sample, we conduct a difference-in-differences (DiD) analysis and confirm the significant reduction in innovation management after the abandonment of annual performance appraisals. These results provide direct evidence that innovation management is closely tied to performance pressures generated by annual evaluation cycles. In contrast, we find little support for alternative explanations involving other stakeholders such as the deadlines of external law firms or managerial incentives.

In the final part of the paper, we examine the relation between innovation management and firms' future performance, motivated by prior research that patent quality can significantly affect financial performance and stock returns (e.g., Hirshleifer, Hsu, and Li 2018). Given that innovation management leads to lower-quality patents, firms with a higher proportion of IM patents in their patent stock may experience weaker future performance. This effect is expected to be more pronounced among firms with high innovation intensity, for whom innovation is a key driver of value creation.

To test this prediction, we estimate firm-level regressions where the dependent variables are future operating cash flow and ROA, measured over the next two years. For high-innovation intensity firms, defined as those with cumulative patent filings above the annual sample median, we find that a greater share of IM patents in patent stock is associated with significantly lower

future financial performance. Economically, a one-standard-deviation increase in the proportion of IM patents is associated with a 0.92 percentage-point decline in ROA, representing a 13% reduction relative to the mean. Additionally, Fama-MacBeth regressions of monthly stock returns show that, for high innovation intensity firms, a higher proportion of IM patents also experience significantly lower future stock returns.⁴

Our paper makes three main contributions to the literature. First, while existing research has shown that conventional performance measurement can distort financial metrics and induce opportunistic behavior among managers (Jones 1991; Dechow, Sloan, and Sweeney 1995; Roychowdhury 2006), we extend this insight to non-executive employees and nonfinancial performance metrics. Specifically, we document a previously unrecognized form of real activity manipulation by corporate inventors, whereby performance pressure leads to the filing of excessive low-quality patents. In doing so, we provide evidence that broadens the scope of distortion-based theories (Healy 1985; Healy and Wahlen 1999) from financial outcomes to nonfinancial metrics such as innovation output, and from managerial behavior to that of non-executive employees.

Second, our findings contribute to a deeper understanding of nonfinancial performance metrics, such as innovation output, ESG scores, and customer satisfaction, which are increasingly used by stakeholders to complement traditional financial metrics. These nonfinancial metrics are widely regarded as value-relevant but noisy. We show that the concern extends beyond noise, as nonfinancial metrics can be actively manipulated, especially given their growing importance. Employees and firms respond not only to what is measured, but also to how it is measured. In the context of patent filings, our findings echo the well-documented phenomenon of greenwashing and illustrate that once nonfinancial metrics become targets for valuation, they can also become

⁴ We also examine firms with low innovation intensity and find that, consistent with our prediction, there is little relationship between the proportion of IM patents and future financial performance and stock returns.

targets of manipulation.

Third, our paper contributes to the literature on innovation, particularly the determinants of innovation quality. While high-quality innovation is a critical driver of economic growth and firm performance, concerns persist about the proliferation of low-quality patents (e.g., Pakes 1986; Hall, Jaffe, and Trajtenberg 2001; Frakes and Wasserman 2015). Existing literature has largely focused on the fundamental drivers of patent quality. We extend this literature by highlighting the role of opportunistic behavior in influencing patent quality.⁵ Moreover, our findings speak to the literature on the optimal design of incentive systems to foster high-quality innovation. Specifically, we complement the studies that emphasize the importance of long-term evaluation and incentives in motivating innovation (e.g., Lerner and Wulf 2007; Manso 2011; Erkens 2011; Ederer and Manso 2013), by providing novel evidence that short-term performance evaluations can distort innovation behavior and outcomes.

1. INSTITUTIONAL BACKGROUND: PERFORMANCE REVIEW OF INVENTORS

Patent-based measures are commonly used to evaluate inventors' job performance (e.g., Hertenstein and Platt 2000; Zenger and Lazzarini 2004; Balasubramanian, Lee, and Sivadasan 2018; Wabnegg 2024). Common output metrics include the number of patent applications, granted patents, and patent citations. Survey evidence indicates that majority of inventors consider the number of patent applications as a crucial criterion in their performance reviews.

The patent filing process within a firm typically begins with inventors submitting a one- to two-page disclosure outlining their idea to the internal review committee. This committee typically comprises senior R&D managers and legal staff (internal counsel) and is responsible for assessing

⁵ A small but growing literature has examined inventors' opportunistic behavior. For example, Armstrong, Glaeser, Park, and Timmermans (2026) show that strengthening employer's legal claim over employees' patents can reduce inventors' opportunistic behavior and improve innovation dissemination.

the idea’s patentability. If the committee approves the idea for a patent application, the process of drafting the patent application begins. Inventors are primarily responsible for drafting the applications, with potential input from patent attorneys. Once finalized, the application is filed with the relevant USPTO patent office, either by either an internal legal counsel or an external law firm. The assigned attorney also handles further interactions with USPTO examiners until the patent is granted.

For inventors seeking to opportunistically boost their performance prior to annual evaluations, increasing the number of patent filings is the most viable method. This is because the patent filing date is relatively easier for inventors to influence, particularly for those familiar with a firm’s patent filing procedures and timelines. In contrast, the other two commonly used metrics, patent grants and citation counts, are far less controllable due to their inherent delays and uncertainty. For example, it typically takes over a year for a patent application to be assigned to an examiner, and more than three years to be granted.

2. DATA AND SAMPLE CONSTRUCTION

2.1 Data and Sample

We obtain data on all patents filed in the United States between 1980 and 2019 from the USPTO, including information on patent application numbers, patent numbers, filing dates, examiner art units, and technology classes. We then match these patents to publicly listed firms using the patent-public firm linkage file from the KPSS database.⁶ As the KPSS file only covers granted patents, our sample is restricted to granted patents. We obtain inventor information and patent text from the PatentsView database, CEO compensation data from the Capital IQ database,

⁶ We thank the authors of Kogan, Papanikolaou, Seru, and Stoffman (2017) for making this dataset available at <https://github.com/KPSS2017/Technological-Innovation-Resource-Allocation-and-Growth-Extended-Data>.

firm-level financial information from Compustat, and monthly stock return data from CRSP.

We obtained data on patents filed with the China National Intellectual Property Administration by Chinese listed firms from the CSMAR database. To identify patents filed with the USPTO from other countries or regions, we use the patent applicant country code provided by the PatentsView database. PatentsView also supplies information on the nature of applicants, whether they are individuals, corporations, government agencies, or universities. To mitigate the influence of outliers, we winsorize all continuous variables at the 1st and 99th percentiles.

2.2 Summary Statistics

Table 1 presents the summary statistics for the variables used in our analyses. Our final sample comprises 2,259,890 patents filed by US public firms during 1980 to 2019. On average, patents in our sample receive 13 future citations, with about 24% receiving zero citations. The average patent contains 17 claims. The mean originality score is about 9, indicating that each patent cites on average nine distinct technology subclasses. The average description section contains 4,830 words, and each patent document includes about 12 figures and 9 sheets.

In a given year during our sample period, an average inventor in our sample has nine years of work experience and has filed 23 patents. At the firm-year level, the average firm holds a patent stock of 284 patents, is about 22 years old, reports R&D expenditures about 9% of total assets, and has an ROA of -0.07. At the firm-month level, firms file an average of four patents per month, and the average monthly stock return is about 1%. Detailed variable definitions are provided in Appendix A.

3. INNOVATION MANAGEMENT AND FISCAL YEAR-END PATENT FILINGS

3.1 Seasonality in Corporate Patent Filings

We begin by examining whether corporate patent filings exhibit seasonal patterns

throughout the year. Panel A of Figure 2 plots the monthly distribution of patent filings by U.S. public firms from 1980 to 2019. We observe a pronounced spike in filings during December, which accounts for 10.12% of all patent filings, significantly higher than the average of 8.17% across the months from January to November.

Since annual performance reviews are typically conducted at the end of fiscal year rather than the calendar year, we further investigate whether this December spike reflects a fiscal year-end (FYE) effect. To do so, we separate the sample into two groups: firms with fiscal year-ends in December and those with fiscal year-ends in other months. Panel B of Figure 2 shows that firms with December fiscal year-ends demonstrate a pronounced spike in December filings, consistent with the full-sample pattern. In contrast, Panel C shows no such increase for firms whose fiscal years end in months other than December. This distinction suggests that the increase in patent filings is a fiscal year-end phenomenon, consistent with inventors accelerating patent filings in response to performance evaluation pressures, what we term opportunistic *innovation management*.

We therefore focus on the seasonality of patent filings through the fiscal year for all our sample firms. Panel A of Figure 3 plots the distribution of patent filings by fiscal month. During 1980 to 2019, public firms file a total of 262,719 patents in the final month of their fiscal year, compared to an average of 183,589 patents filed in a non-fiscal year-end month, which represents a 43.1% increase. To confirm that this pattern is driven by fiscal year-end timing rather than the calendar year-end (i.e., December), we examine the subset of firms whose fiscal years end in months other than December. Panel B of Figure 3 shows that these firms file 47.4% more patents in their respective FYE months compared to other months, confirming that the spike in patent filings is a FYE phenomenon.

Moreover, Figure 4 plots the annual difference in patent filings between the fiscal year-

end month and other months for each year during our sample period. We find that the surge in fiscal year-end filings, i.e., innovation management, persists consistently in every year from 1980 to 2019. To assess whether this seasonality is unique to corporate patent activity or reflects a broader trend, we examine patent filings by individuals in Figure 5. Contrary to corporate filers, we find no comparable spike in filings by individual inventors, suggesting that the observed seasonality is specific to firms and likely driven by organizational processes such as performance evaluation.

We then examine whether innovation management is concentrated in certain types of firms or technology fields. Figure 6 shows that the seasonality in patent filings is pervasive across all industries, as classified by one-digit SIC codes (Panel A), except for the agriculture sector. A similar pattern is observed across USPTO technology classes, as defined by the examiner art units (Panel B). Moreover, Figure 7 reveals that innovation management occurs across firms of all sizes, whether classified by market capitalization (Panel A) or total assets (Panel B). These results suggest that innovation management is a widespread phenomenon among U.S. public firms.

One potential concern is that, since our sample includes only granted patents, the observed surge in FYE patents could be driven by a higher grant rate for patent applications filed in the FYE month compared to other months.⁷ For example, if patent applications filed in FYE months are of higher quality, then firms could exhibit a greater number of granted patents filed in those months even if the number of applications is constant throughout the year. To address this concern, we calculated the grant rate for each month as the number of granted patents filed in that month divided by the total number of patent applications filed in the same month. As shown in Figure 8, the grant rate for applications filed in December is slightly lower, rather than higher, than other

⁷ Note that it takes, on average, over a year for a patent application to be assigned to a USPTO examiner, so it is uncertain in which months the application will be assigned and reviewed.

months. While this analysis does not distinguish between public firms and other types of applicants, it is informative given that over 65% of public firms have a December fiscal year-end.⁸ This finding therefore provides suggestive evidence that the observed surge in granted patents is unlikely to be driven by higher grant rates for FYE filings.

Next, we examine whether innovation management extends beyond the United States. Specifically, we examine the seasonality of patent filings by Chinese public firms with the China National Intellectual Property Administration. We obtain the patent data of Chinese public firms during 2004 to 2023 from the CSMAR database. Notably, all publicly listed firms in China have a fiscal year ending in December. Panel A of Figure 9 shows that Chinese firms exhibit a pronounced spike in December patent filings, with 16.64% of all patents filed in that month, significantly higher than the average of 7.58% across other months. This pattern indicates that innovation management among Chinese public firms is not unique to US firms and is even more pronounced among Chinese public firms.

We further examine whether innovation management is present in other places over the world by analyzing patent filings with the USPTO by firms based in Australia, Germany, Switzerland, the UK, Finland, France, Taiwan, Japan, Mainland China, and Korea. These places are selected because their companies have homogeneous fiscal year and each has filed more than 10,000 patents with the USPTO from 1980 to 2019.⁹ Panel B of Figure 9 shows the percentage difference between the number of patents filed in FYE month and the average number filed in other months. Consistent with our U.S. findings, we observe a pronounced spike in FYE patent filings, with percentage differences ranging from 5% to 50%. These results suggest that innovation

⁸ We are unable to conduct this analysis for the subsample of public firms because the KPSS linkage file includes only the granted patents of public firms.

⁹ For example, Japanese firms have a fiscal year-end in March, Australian firms in June, and German and Swiss firms in December.

management is not confined to the U.S. or China but is a global phenomenon.

Finally, we conduct formal regression analysis to further examine the presence of innovation management. Specifically, we estimate the following firm-month panel regression:

$$\#Patents_{i,m} = \beta_0 + \beta_1 FYE_i + \beta_2 Market\ Cap_{i,t} + \beta_3 \ln(Patent\ Stock)_{i,t} + \eta_i + \gamma_t + \varepsilon \quad (1)$$

where $\#Patents_{i,m}$ is the number of patents filed by firm i in month m , and FYE_i is a dummy variable equal to one if month m is the firm's fiscal year-end. We control for firm size, patent stock, firm fixed effects and year fixed effects.¹⁰ Robust standard errors are clustered at the firm level to account for heteroscedasticity and serial correlation. For robustness, we conduct both OLS regressions and Poisson regressions (Cohn, Liu and Wardlaw 2022). Table 2 presents the regression results. The coefficient on FYE is positive and significant at the 1% level in all models. For example, in the OLS regression (Column 2), firms file 1.30 additional patents in the FYE month relative to other months, representing a 33.8% increase over the sample mean of 3.85 patents per month. The Poisson regression (Column 4) shows a similar result, indicating a 31.5% increase in monthly patent filings during the FYE month.

3.2 Innovation Management and Patent Quality

If innovation management is caused by inventors' opportunistic behavior, we would expect patents filed in the fiscal year-end month to be of lower quality compared to those filed in other months. To test this conjecture, we construct five patent quality measures following literature. The first two are the total number of forward citations and the truncation-adjusted citations (Hall, Jaffe, and Trajtenberg 2001, 2005). The third measure is patent originality, which captures the extent to which a patent combines diverse technologies and reflects novelty (Hsu, Tian, and Xu, 2014; Hirshleifer, Hsu, and Li 2018). The fourth measure is a dummy variable for patents receiving no

¹⁰ The regression sample includes only firms that file at least one patent in a year.

future citations (Balsmeier, Fleming and Manso 2017), and the fifth is a dummy variable for breakthrough patents that equals one if a patent's forward citation count falls in the top 5% of all patents (Singh and Fleming 2010).

We estimate the following patent-level regression to examine whether fiscal year-end filings are associated with lower patent quality:

$$\text{Patent Quality}_d = \beta_0 + \beta_1 \text{FYE Patent}_d + \lambda_a + \eta_i + \gamma_t + \varepsilon \quad (2)$$

where *Patent Quality_d* is one of the five patent-quality measures discussed above, and *FYE Patent_d* is a dummy variable equal to one if patent *d* is filed in the firm's FYE month. We control for art unit, firm, and filing year fixed effects and report t-statistics using robust standard errors adjusted for heteroscedasticity and clustered at the firm level.

Panel A of Table 3 presents results using the two citation-based measures, raw citations and truncation-adjusted citations. The coefficient on *FYE Patent* is negative and significant at the 5% or 1% level, revealing a significant decrease in patent quality for patents filed in the FYE month. The effects are also economically significant. Patents filed in the FYE months on average receive 4.0% fewer raw citations and 3.7% fewer adjusted citations compared to other patents.

Panel B of Table 3 presents regression results using the remaining three patent quality measures. The coefficient on *FYE Patent* is negative and significant at the 1% level in Columns (1) and (3), and positive and significant at the 1% level in Column (2), where the dependent variable is the no citation indicator. These results consistently indicate that patents filed during the FYE month are of lower quality than those filed in other months. Specifically, FYE patents are less novel, less likely to be breakthroughs, and more likely to receive no future citations. The magnitudes are also economically meaningful, with quality differences ranging from 2% to 5% across the three measures. Overall, the results in Table 3 suggest that the surge in FYE patent

filings is associated with lower patent quality, consistent with opportunistic behavior by inventors in response to performance evaluation pressures.

3.3 Identifying Patents Associated with Innovation Management

As shown in Table 3, the overall quality difference between FYE patents and patents filed in other months appears modest, ranging from 2% to 5%. However, it is important to note that not all FYE patents result from opportunistic behavior. FYE filings may include both routine (non-opportunistic) patents and those strategically filed to meet performance evaluation targets. Therefore, the aggregate quality difference reported in Table 3 likely underrepresents the true reduction in quality caused by opportunistic innovation management.

To best isolate the effects of opportunistic patent filings, we divide FYE patents into two groups: IM (innovation management) patents and non-IM patents. This classification is based on inventors' tendency to file patents in the FYE month. Specifically, for each inventor, we calculate an annual FYE tendency, defined as the proportion of the inventor's patents in that year that are filed during the FYE month. We then compute the average FYE tendency across all inventors listed on a given FYE patent. For example, consider a patent filed by inventors A, B, and C. Inventor A's FYE tendency is $1/12$, i.e., $1/12$ of her patent filings in this year are in the FYE month. Inventors B and C's FYE tendencies are $1/3$ and $3/4$, respectively. Then the average inventor FYE tendency for the patent is $(1/12 + 1/3 + 3/4)/3 = 0.389$. We classify a FYE patent as an IM patent if its average inventor FYE tendency is above the median FYE tendency among all FYE patents in the prior year. We use the median of the prior year to avoid look-ahead bias. The intuition behind this approach is that inventors with an abnormally high concentration of FYE filings are more likely to be engaging in opportunistic behavior, and therefore, their patents are more likely to reflect opportunistic innovation management.

Table 4 presents patent-level regression results comparing the quality of two subgroups of FYE patents: IM patents and non-IM patents. Panel A of Table 4 presents regressions using the full sample. The coefficient on *IM Patent* is negative and significant at the 1% level in all models. The Economically, IM patents receive 6.9% fewer raw citations and 7.9% fewer adjusted citations compared to other patents. These effects are much larger than those in the baseline analysis, suggesting that our classification effectively isolate patents likely driven by opportunistic behavior and sharpen the analysis of quality differences.

In Panel B, we refine the comparison by excluding non-IM patents and directly comparing IM patents with non-FYE patents. The coefficient on *IM Patent* remains negative and significant at the 1% level, consistent with Panel A. Panel C presents the results for non-IM patents compared to non-FYE patents, excluding IM patents from the sample. The coefficient on *Non-IM Patent* is either marginally significant at the 10% level or statistically insignificant with a small magnitude, suggesting that non-IM patents are comparable in quality to patents filed outside the FYE months. Overall, the results in Table 4 reinforce the conclusion that the decline in patent quality is concentrated among patents associated with opportunistic innovation management.

Table 5 complements Table 4 by presenting results based on the remaining three patent quality measures, *Originality*, *No Citation*, and *Breakthrough Patent*.¹¹ Panel A presents regression results using the full sample. The coefficient on *IM Patent* is negative and significant at the 1% level in Columns (1) and (3), and positive and significant at the 1% level in Column (2). These results are also economically significant, indicating that IM patents have 7% to 10% lower quality based on the three measures.

Panel B of Table 5 is analogous to Panel B of Table 4, except it uses the remaining three

¹¹ The sample size in Table 5 is slightly smaller than that in Table 4 because calculating the *Originality* measure requires information on technology class and subclass for the references cited by the focal patents.

quality measures instead of citation measures. The coefficient on *IM Patent* is negative and significant in Columns (1) and (3), and positive and significant in Column (2), consistent with Panel A. Panel C of Table 5 is analogous to Panel C of Table 4 while using the remaining three measures. The coefficient on *Non-IM Patent* is positive in Column (1), positively significant with much smaller magnitude compared to IM patents in Column (2) (0.022 and 0.004, respectively) and statistically insignificant in Column (3). These results confirm that the quality deterioration is concentrated among IM patents, while non-IM patents are broadly comparable in quality to patents filed outside the FYE months.

In robustness tests, we use an alternative approach to identify patents associated with innovation management that accounts for industry-specific filing behavior. Under this method, a patent is classified as *IM Industry Patent* if its FYE tendency is above the median of firms in the same two-digit SIC industry in the prior year. The results on patent quality using this alternative classification, reported in Table B1 of Appendix B, are consistent with our baseline findings.

3.4 Innovation Management and Pre-Mature Patent Filings

The observed decline in the quality of IM patents could result from two distinct mechanisms. First, inventors might file patents that lack sufficient scientific merit and are not originally intended for submission. Second, inventors might accelerate the filing of patents would have otherwise been submitted in subsequent periods, a form of “borrowing” from the future. In the latter case, the rushed applications are likely to be less developed, resulting in lower quality. While the first mechanism is difficult to test directly, we focus on the second by examining whether innovation management is associated with a reduction in patent filings in the months following the fiscal year-end. We also assess the disclosure quality of patent applications as an indicator of premature patent filings.

3.4.1 Innovation Management and Subsequent Patent Filings

We test for the presence of premature patent filings using the following firm-level regression:

$$\#Subsequent\ Patent\ Filings_{i,t+1} = \beta_0 + \beta_1 \%IM_{i,t} + \beta_2 Controls_{i,t} + \eta_i + \gamma_t + \varepsilon \quad (3)$$

where $\#Subsequent\ Patent\ Filings_{i,t+1}$ is the total number of patent filings by firm i in fiscal year $t+1$, measured separately for months 1 to 3, 4 to 6, and 7 to 9. The independent variable $\%IM_{i,t}$ is the intensity of innovation management in fiscal year t , defined as the percentage of IM patents among all patents filed by the firm in that year. We include firm and year fixed effects and report t-statistics using robust standard errors adjusted for heteroscedasticity and clustered at the firm level.

Table 6 presents the regression results. In Column (1), the coefficient on $\%IM$ is negative and significant (t-statistic = -2.44), suggesting that a higher incidence of innovation management leads to a significant reduction in patent filings during the first quarter of the following fiscal year. In Column (2), the coefficient remains negative, though smaller and marginally significant (t-statistic = -1.77). In Column (3), the coefficient is also negative but statistically insignificant (t-statistic = -1.29). These results are consistent with the mechanism of premature patent filings, particularly by shifting applications from the near future to the fiscal year-end.

3.4.2 Innovation Management and Disclosure Quality of Patents

We further investigate the mechanism of premature patent filings by examining disclosure quality. If innovation management involves rushing applications that are not yet fully developed, such patents should exhibit lower disclosure quality compared to their peers. Following Dyer et al. (2024), we construct four measures of disclosure quality, including the number of words in the description section, text readability, the number of figures, and the number of sheets. We expect

prematurely filed patents to have shorter descriptions, lower readability, and fewer visual elements.

To formally test this prediction, we estimate the following patent-level regression:

$$\text{Disclosure Quality}_d = \beta_0 + \beta_1 \text{IM Patent}_d + \lambda_a + \eta_i + \gamma_t + \varepsilon \quad (4)$$

where *Disclosure Quality_d* is one of the four disclosure quality measures of patent *d*, and *IM Patent_d* is a dummy variable equal to one if patent *d* is classified as an IM patent. We control for art unit, firm, and filing year fixed effects and report t-statistics using robust standard errors adjusted for heteroscedasticity and clustered at the firm level.

Panel A of Table 7 presents regression results where the dependent variable is the number of words in the description section. The coefficient on *IM Patent* is negative and significant at the 5% or 1% level, suggesting that IM patents have significantly shorter descriptions than other patents. Panel B presents the results on the readability of the description section using three measures. The *Gunning Fog* index estimates the number of years of formal education required to understand the text on first reading, with higher values indicating lower readability. Similarly, the *Automated Readability* index estimates the U.S. grade level needed to understand the text, with higher values indicating lower readability. In contrast, the *Flesch Reading* index ranges from 0 to 100, with higher values indicating greater readability. To make all three measures indicate readability in the same direction, we multiply the *Flesch Reading* score by -1. The coefficient on *IM Patent* is positive and significant in all models, suggesting that IM patents are systematically less readable than other patents.

Panel C of Table 7 presents regression results using the numbers of figures and sheets in the patent text as dependent variables. Many patents have a spatial or visual component, where figures and sheets serve as effective tools for illustrating complex concepts, summarizing information efficiently, and enhancing the overall transparency of the disclosure. We find that the

coefficient on *IM Patent* is negative and significant in both models, suggesting that patents associated with innovation management contain fewer figures and sheets than their peers. This finding is consistent with IM patents being less thoroughly developed at the time of filing.

To complement the disclosure quality measures based on textual analysis, we use an alternative measure of disclosure quality: the number of claims in a patent. Patents with more claims offer broader legal protection, suggesting higher patent quality (e.g., Marco, Sarnoff, and Charles 2019; Ganglmair, Robinson, and Seeligson 2022). We expect premature patent filings to have fewer claims than their peers. Panel D of Table 7 presents regression results using this alternative measure. Column (1) shows that IM patents have significantly fewer claims than their peers. Columns (2) and (3) further distinguish between independent and dependent claims. Independent claims are more important, as they define the fundamental scope of the invention, while dependent claims describe specific embodiments that fall under the broader protection of the independent claims (Marco, Sarnoff, and Charles 2019). The coefficient on *IM Patent* is significantly negative in both regressions, with a larger magnitude and higher significance for independent claims. Overall, the results in Table 7 further support the mechanism of premature patent filings in innovation management.

4. INNOVATION MANAGEMENT: INVENTOR INCENTIVES AND CONSEQUENCES

Innovation management is consistent with opportunistic behavior by inventors responding to pressure from annual performance appraisals. In this section, we further explore the incentives underlying such behavior by investigating how innovation management varies with inventor characteristics. We then examine the consequences of innovation management to inventors, focusing on its short-term benefits and long-term costs in terms of job security.

4.1 Innovation Management and Inventor Characteristics

It has been well documented that individuals' career concerns influence their decision-making (Prendergast and Stole 1996; Holmstrom 1999). In this subsection, we examine three inventor characteristics that are likely to be associated with stronger incentives for innovation management. The first characteristic is motivated by tournament behavior documented in the mutual fund industry, where managers who are underperforming mid-year tend to increase risk-taking in the latter half of the year (e.g., Brown, Harlow, and Starks 1996). Similarly, inventors who are trailing in patent filings earlier in the year may face greater pressure and are more likely to engage in innovation management by accelerating patent filings towards the fiscal year-end.

To test this prediction, we estimate the following patent-level regression:

$$IM\ Patent_d = \beta_0 + \beta_1\ Trailing_d + \lambda_a + \eta_i + \gamma_t + \varepsilon \quad (5)$$

Where $IM\ Patent_d$ is a dummy variable for IM patents. $Trailing_d$ is measured in two ways. The first, $Trailing_3Qtrs$, is a dummy equals one if the total number of patents filed by an inventor in the first three quarters of the year is lower than the same period of the prior year. The second, $Trailing_11M$, is similarly constructed but based on the first eleven months of the year. We control for art unit, firm, and filing year fixed effects and report t-statistics using robust standard errors adjusted for heteroscedasticity and clustered at the firm level. Panel A of Table 8 presents the regression results.¹² Consistent with our conjecture, the coefficients on both trailing measures are positive and significant at the 1% level, suggesting that inventors who are trailing in patent filings earlier in the year are significantly more likely to engage in innovation management.

Next, we hypothesize that inventors with less experience or a weaker track record may face intensified scrutiny during performance appraisals, leading to a greater tendency to engage in

¹² We follow the baseline analysis and control for firm, filing year, and art unit fixed effects. In untabulated robustness tests, we control for firm-by-filing year fixed effects and art unit fixed effects, and find similar results.

innovation management compared to their more experienced peers. Panel B of Table 8 presents patent-level regression results examining the relation between inventor experience and the likelihood of filing IM patents. We construct two measures of inventor experience based on the inventor's tenure and the cumulative number of patents filed by the inventor up to the previous year. The results show that, consistent with our conjecture, inventors with shorter tenures and fewer historical patents are significantly more likely to file IM patents. A one standard deviation decrease in historical patents leads to a 20.2% increase in the likelihood of innovation management.

Panel C of Table 8 presents the regressions examining the relation between inventors' past performance and their likelihood of engaging in innovation management. We use three measures of past performance: 1) the average adjusted citations of an inventor's past patents, 2) the average patent originality score of those patents, and 3) the total number of breakthrough patents from the inventor up to the previous year. Consistent with our conjecture, we find that inventors with weaker track record are significantly more likely to engage in innovation management.¹³

4.2 Consequences of Innovation Management for Inventors

We further examine the short-term and long-term consequences of innovation management for inventors in terms of job security. On the one hand, engaging in innovation management may help inventors enhance their annual performance and improve short-term job security. On the other, the associated decline in patent quality may harm inventors' reputations and ultimately reduce long-term job security.

To test these conjectures, we follow the literature and identify inventor turnovers by tracking changes in their patent filing history. Specifically, an inventor is assumed to switch

¹³ A patent is typically filed by an invention team with an average of three members, and we include all inventors for each patent in the analysis. We conduct a robustness test by considering only the lead inventors for the patents and find similar results in Table B2 of Appendix B. Overall, the results in this subsection provide evidence supporting the inventor opportunistic innovation management due to inventor performance appraisals.

employers in the midpoint year between two consecutive patents associated with different companies (e.g., Marx, Strumsky, and Fleming 2009; Song, Almeida, and Wu 2003; Liu, Mao, and Tian 2023).¹⁴ We estimate the following inventor-level regression:

$$\text{Turnover}_{i,t+n} = \beta_0 + \beta_1 \% \text{ Inventor IM Patent}_{i,t} + \nu_v + \gamma_t + \varepsilon \quad (6)$$

where $\text{Turnover}_{i,t+n}$ is a dummy variable equal to one if inventor i experiences a turnover in year $t+n$ for $n = 1, 2, \dots, 8$. The main independent variable, $\% \text{ Inventor IM Patent}$, is defined as the number of *IM* patents filed by inventor i in year t , scaled by the total number of patents filed in that year. We control for inventor and year fixed effects, and report t-statistics using robust standard errors adjusted for heteroscedasticity and clustered at the inventor level.

Table 9 presents the regression results. We find that the coefficient is negative and significant at the 5% or 1% level in columns (1) to (4), suggesting that innovation management is associated with a significantly lower probability of inventor turnover in the first four years. However, the coefficient becomes statistically insignificant in columns (5) and (6), and then turn positive and significant in columns (7) and (8), suggesting that the negative consequences, in terms of an increased likelihood of turnover, begin to emerge in later years. These results illustrate the tradeoff between short-term gains and long-term harm associated with innovation management.

5. WHO DRIVES INNOVATION MANAGEMENT?

Innovation and patent development involve multiple stakeholders beyond inventors. While the observed pattern of innovation management is consistent with inventors' opportunistic behavior driven by annual performance appraisal pressures, it could also stem from the influence of other parties, such as external law firms or firm management. In this section, we conduct a set

¹⁴ For example, if an inventor files a patent for Firm A in 2008 and the next for Firm B in 2012, we assume the inventor moves from Firm A to Firm B in 2010.

of balanced analyses to investigate the potential contributions of inventors, external law firms, and corporate managers to the emergence of innovation management.

5.1 Innovation Management and Abandonment of Annual Performance Appraisal

5.1.1 Case Studies

To directly investigate the role of inventors' annual performance appraisals in driving innovation management, we examine changes in innovation management after companies abandon annual performance reviews. In recent years, there has been a growing trend among publicly listed firms to shift away from annual reviews in favor of more continuous, real-time feedback systems. This transition is motivated by the concerns that formal annual appraisals are time consuming, reduce employee productivity, and hurt employee-manager relationships. For example, in August 2015, General Electric announced it had eliminated annual performance reviews to foster a more positive work environment and appeal to younger employees.¹⁵ According to a Washington Post article, as of 2015, approximately 6% of Fortune 500 companies had discontinued traditional annual review systems.¹⁶ If the innovation management is driven by inventors' performance reviews, we would expect a significant decline in such behavior following the abandonment of annual performance reviews.

Because there is no readily available data on the abandonment of annual performance reviews, we conduct a targeted search using Google with the keywords related to the abandonment of annual performance reviews. This search generates three reports identifying four public companies, Medtronic PLC, Microsoft, General Electric, and Eli Lilly, that abandoned traditional

¹⁵ For details, see the CNBC article at <https://www.cnbc.com/2015/08/19/general-electric-rethinks-from-annual-job-reviews.html>.

¹⁶ See <https://www.washingtonpost.com/news/on-leadership/wp/2015/07/21/in-big-move-accenture-will-get-rid-of-annual-performance-reviews-and-rankings/>.

annual performance reviews during our sample period.¹⁷ Panels A to D of Figure 10 plot the percentage of FYE patent filings for each of these four companies before and after the abandonment of annual reviews. Consistent with our prediction, all four firms exhibit a notable decline in the share of FYE patent filings following the change. To ensure this decline is not driven by broader trends in innovation management, we examine a matched sample of four highly innovative firms, Micron Technology, Texas Industries Inc, Halliburton Co., and Sony Group. As shown in Panels E to H of Figure 10. These benchmark firms exhibit no similar decline in FYE patent filings. These findings provide direct evidence that the innovation management behavior is driven by inventors' annual performance appraisals.

5.1.2 S&P 500 Firms

Motivated by the four case studies, we expand the event sample by conducting a broader search among S&P 500 firms. Specifically, for each firm in the index, we conduct a keyword search combining the company name with terms related to the abandonment of annual performance reviews. In addition, we search for these keywords within firms' annual reports over our sample period. This approach identifies ten additional firms that discontinued traditional annual performance appraisals during the sample period.¹⁸

We construct a larger event sample by combining the initial four event firms with the ten additional firms in our expanded search, resulting in a total of 14 firms. We then plot an aggregate version of Figure 10 using the average share of FYE patents across these firms. Panel A of Figure 11 shows a significant decline in the percentage of FYE patent filings following the event year,

¹⁷ See the three reports at: <https://www.shrm.org/topics-tools/news/employee-relations/annual-performance-review-dead>; <https://victorhrconsultant.com/2018/04/17/eliminating-performance-ratings-managers-ability-to-deliver-feedback-is-essential/>; and <https://www.benefitnews.com/news/are-performance-reviews-dead>. These four firms either abandon the annual performance review entirely, or transition away from traditional annual performance reviews by eliminating stacked rankings in favor of more continuous, real-time feedback-based evaluation systems.

¹⁸ These ten firms are Netflix (2009), Adobe (2012), Autodesk (2012), Juniper Networks (2012), Accenture (2015), Cigna (2015), Cisco (2016), IBM (2016), JPMorgan Chase (2017), and Intel (2019).

consistent with a reduction in innovation management after the abandonment of annual performance reviews. To verify that this pattern is not driven by broader trends, we also plot the corresponding metric for the remaining S&P 500 firms. As shown in Panel B, we observe no comparable decline.

We formally test whether abandoning traditional annual performance reviews reduces innovation management using a DiD framework. Specifically, we regress % *IM Patent*, defined for a firm-year as the number of IM patents filed by the firm in the year divided by the firm's total patent filings in the year, on *Firm Abandonment*, a dummy variable equal to one for firms in and after the year they announce the abandonment of annual reviews, and zero otherwise. Table 10 reports the regression results.¹⁹ In column (1), the coefficient on *Firm Abandonment* is negative and significant at the 5% level, indicating that innovation management significantly decreases after the abandonment. Column (2) include firm-level controls, and the coefficient remains negative and significant. These findings support the view that innovation management is linked to inventors' performance pressure arising from annual appraisal systems.

5.2 Alternative Explanation of Innovation Management: External Law Firms

The majority of firms engage external law firms to assist inventors in preparing and submitting patent applications. As such, the incentives of these legal service providers could also influence the timing of patent filings. Balasubramanian, Lee, and Sivadasan (2018) document that patent applications are disproportionately filed at the end of the month and attribute this pattern to attorneys' behavior, driven by month-end billing cycles. One potential concern, therefore, is that the observed innovation management, i.e., FYE spike in patent filings, may be driven by the incentives of external lawyers rather than inventors. However, this explanation is unlikely. External

¹⁹ The results are consistent when we replace % IM Patent with % FYE Patent.

law firms typically operate on monthly billing cycles, which incentivize attorneys to finalize and submit filings by the end of each calendar month to expedite invoicing and payment, rather than to align with clients' fiscal year-ends. Moreover, we find that the surge in patent filings is concentrated specifically in each firm's FYE month, not uniformly in December. Given that external law firms are unlikely to share the same fiscal year-ends as their clients, it is improbable that law firm incentives explain the observed FYE-seasonal pattern in innovation management.²⁰

Moreover, our findings differ from those of Balasubramanian, Lee, and Sivadasan (2018) in both implications and underlying mechanisms. In contrast to our finding of fiscal year-end seasonality, their findings on within-month seasonality are unlikely to affect the corporate disclosures of non-financial metrics, which are typically reported on a quarterly or annual basis. Additionally, they find that month-end patent filings are more complex (e.g., containing more claims and figures), which they interpret as evidence of deadline-induced task sorting, where more complex applications are disproportionately completed near internal deadlines. In contrast, we find that IM patents are less complex across these measures. Second, Balasubramanian, Lee, and Sivadasan (2018) report no significant decline in patent quality for month-end patents, while we find that IM patents have significantly lower quality compared to other patents. They also find stronger patterns in industries with shorter technology cycles, where risk of being scooped is greater and time pressure is more binding. In untabulated results, we do not observe similar patterns for IM patents. To summarize, our findings point to a distinct phenomenon of innovation management, which reflects opportunistic behavior by inventors responding to performance evaluation, rather than deadlines of law firms.

²⁰ Balasubramanian, Lee, and Sivadasan (2018) argue that inventors are unlikely to control the precise timing of patent filings. While this argument is likely valid in the context of their within-month analysis, as discussed in Section 1, inventors can still exert influence over the timing of filings across months, which is the relevant horizon in our analysis.

5.3 Alternative Explanation of Innovation Management: Managers

Like inventors, CEOs undergo annual performance appraisals, which can significantly influence their compensation and career outcomes. As a result, managers could possibly instruct inventors to engage in innovation management to enhance their firms' apparent performance and in turn their own evaluations. To investigate this alternative explanation, we conduct two analyses focused on CEO long-term incentives and past firm performance.

CEO's long-term incentives can align managerial actions with shareholder interests and reduce opportunistic behavior (e.g., Eisenhardt 1989; Makri et al. 2006). If innovation management is primarily driven by CEO-level opportunism, we would expect firms led by CEOs with stronger long-term incentives to exhibit less innovation management activity. To test this hypothesis, we estimate firm-year-level regressions in which the dependent variable is *%IM*, defined as in Section 5.1. The primary independent variable is the strength of CEO long-term incentives.²¹

We follow previous literature and construct two measures of CEO long-term incentives. The first measure, *Career Horizon*, is defined as the estimated number of years remaining until the CEO's expected departure due to retirement or termination (Antia, Pantzalis, and Park 2010; Lee, Park, and Folta 2018). The second measure, *Unexercised Options*, is calculated as the value of unexercised stock options scaled by total compensation, with higher values indicating a longer CEO horizon.²² Panel A of Table 11 presents the regression results, in which the coefficient on CEO long-term incentives is statistically insignificant across all models, suggesting that innovation management is unlikely to be driven by CEO incentives.

²¹ This analysis includes only firm-years with at least one patent filings, where *% IM Patent* can be calculated.

²² The sample period for the CEO analysis is from 1994 to 2019, as the first available year of detailed CEO compensation data in the Capital IQ database is 1994.

We further investigate whether CEO performance is associated with innovation management. CEOs with weaker performance may face increased appraisal pressure, potentially driving innovation management. We examine this possibility using stock returns and ROA from both the current and prior year as proxies for CEO performance. In Panel B of Table 11, we find little relation between these measures and innovation management, which is inconsistent with the explanation based on managerial incentives. To summarize, the results in this section suggest that innovation management is likely driven by inventors' pressure from annual performance appraisal rather than the behavior of law firms or managers.

6. INNOVATION MANAGEMENT AND FIRM PERFORMANCE

Patent quality can significantly affect a firm's financial performance and stock returns (e.g., Shu, Tian, and Zhan 2022). Our results so far suggest that patents involving innovation management are of significantly lower quality compared to other patents. In this section, we examine whether these patents affect firms' future financial performance and stock returns.

6.1 Innovation Management and Future Financial Performance

We begin by examining the relation between innovation management and firms' future financial performance. Since innovation management leads to lower patent quality, firms with a higher proportion of IM patents in their patent stock could experience weaker future financial performance. We focus this analysis on firms with high innovation intensity, where innovation is a key driver of their performance. For comparison, we also conduct a placebo test using firms with low innovation intensity.

We estimate the following firm-level regression:

$$\text{Financial Performance}_{i,t+n} = \beta_0 + \beta_1 \text{Proportion IM}_{i,t} + \beta_2 \text{Controls}_{i,t} + \eta_i + \gamma_t + \varepsilon \quad (7)$$

where the dependent variable is a measure of firm's future financial performance, including

operating cash flow or ROA for the next year and the next two years. The main independent variable, *Proportion IM*_{*i,t*}, is defined as the cumulative number of IM patents up to the current year, scaled by the total cumulative number of patents filed up to the current year (henceforth patent stock). We exclude utility firms (SIC codes from 4900 to 4999) and financial firms (SIC codes from 6000 to 6999) for this analysis. We follow the literature and control for a broad set of firm characteristics including patent stock, firm size, firm age, leverage, cash holdings, book-to-market, R&D expenditures, capital expenditures, PPE, as well as firm and year fixed effects. We report t-statistics using robust standard errors adjusted for heteroscedasticity and clustered at the firm level.

Panel A of Table 12 presents regression results for high innovation intensity firms. A firm is defined as high innovation intensity in a given year if its patent stock in the year exceeds the annual sample median. The coefficient on *Proportion IM* is negative and significant in all models, suggesting that firms with a higher proportion of IM patents in their patent stock experience weaker future financial performance. The magnitude is also economically large. For example, a one standard deviation increase in *Proportion IM* is associated with a 0.92 percentage point decrease in ROA, equivalent to a 13.1% reduction relative to the mean.

As a placebo test, Panel B of Table 12 presents the results for low innovation intensity firms. Consistent with our expectations, the coefficient on *Proportion IM* is insignificant across all models. Taken together, the results in Table 12 suggest that patents involving innovation management, relative to other patents, have a significantly negative effect on firms' future financial performance, particularly in firms that are highly dependent on innovation output.

6.2 Innovation Management and Future Stock Returns

Existing literature documents significant investor underreaction to information associated with corporate innovation (Cohen, Diether, and Malloy 2013; Fitzgerald et. al. 2021; Shu, Tian,

and Zhan 2022). If investors similarly underreact to the negative effect of innovation management, firms with a higher proportion of IM patents in their patent stock may experience lower subsequent stock returns when the negative effects are eventually reflected in firm value. We therefore examine the relation between innovation management and future stock returns.

We estimate Fama-MacBeth regressions in which the dependent variable is the firm's monthly stock return from July year t to June year $t+1$, and the key independent variable is *Proportion IM* in year $t-1$. We control for firm characteristics corresponding to price factors, including patent stock, market capitalization, book-to-market, past one-year returns up to month - 2, past one-month return, asset growth and ROE. We also include industry fixed effects. We follow the literature and drop penny stocks that are priced below \$5.

Panel A of Table 13 presents the regression results for high innovation intensity firms. The coefficient on *Proportion IM* is negative and significant at the 5% level in all models, suggesting that firms with a higher proportion of IM patents experience lower future stock returns. Panel B presents the corresponding results for low innovation intensity firms. In contrast, the coefficient on *Proportion IM* is insignificant in all models, suggesting little correlation between IM patents and future stock returns in firms less reliant on innovation. These results are consistent with the financial performance results in Table 12 and further support the view that innovation management imposes long-term costs, particularly in innovation-intensive firms.

7. CONCLUSION

This paper examines whether corporate inventors, incentivized by annual performance appraisals, engage in opportunistic innovation management by filing an excessive number of low-quality patents. Using data on U.S. public firms, we document a 43% surge in patent filings during fiscal year-end (FYE) months compared to other months, a pattern that persists across time, firm

sizes, industries, technologies, and even across countries. Patents associated with this behavior exhibit significantly lower quality, consistent with strategic responses to performance evaluation pressure.

We further find that innovation management is more pronounced among inventors who are trailing in patent filings earlier in the year, have less experience, or exhibit weaker prior performance, suggesting that appraisal-driven incentives disproportionately affect more vulnerable inventors. While this behavior is associated with lower short-term inventor turnover, likely reflecting improved performance evaluations, it ultimately results in higher inventor turnover in later years, consistent with reputational costs from lower-quality innovation.

Importantly, we find that innovation management declines significantly after the abandonment of annual performance appraisals, providing direct evidence that fixed-term appraisal systems contribute to this behavior. Finally, we show that innovation management has lasting negative consequences. Firms with a higher proportion of innovation-management-related patents in their patent stock experience significantly lower future financial performance and stock returns, particularly among innovation-intensive firms.

As nonfinancial metrics play an increasingly central role in today's economy, stakeholders have devoted growing attention and resources to measuring and acting upon them. While existing literature has extensively documented how performance measurement distorts financial metrics and managerial behavior, much less is known about analogous distortions in nonfinancial metrics and among non-executive employees. By documenting a previously unrecognized form of real activity manipulation by corporate inventors, our study shows that the process of observing and evaluating nonfinancial metrics, such as innovation output, can fundamentally alter the behavior these metrics are intended to measure.

REFERENCES

- Antia, Murad, Christos Pantzalis, and Jung Chul Park, 2010, CEO decision horizon and firm performance: An empirical investigation, *Journal of Corporate Finance* 16, 288-301.
- Armstrong, Christopher S., Stephen Glaeser, Stella Y. Park, and Oscar Timmermans, 2026, The assignment of intellectual property rights and innovation, *Journal of Accounting Research*, forthcoming.
- Balasubramanian, Natarajan, Jeongsik Lee, and Jagadeesh Sivadasan, 2018, Deadlines, workflows, task sorting, and work quality, *Management Science* 64, 1804-1824.
- Balsmeier, Benjamin, Lee Fleming, and Gustavo Manso, 2017, Independent boards and innovation, *Journal of Financial Economics* 123, 536-557.
- Ben-David, Itzhak, Francesco Franzoni, Augustin Landier, and Rabih Moussawi, 2013, Do hedge funds manipulate stock prices? *Journal of Finance* 68, 2383-2434.
- Brown, Keith C., W. Van Harlow, and Laura T. Starks, 1996, Of tournaments and temptations: An analysis of managerial incentives in the mutual fund industry, *Journal of Finance* 51, 85-110.
- Carhart, Mark M., Ron Kaniel, David K. Musto, and Adam V. Reed, 2002, Leaning for the tape: Evidence of gaming behavior in equity mutual funds, *Journal of Finance* 57, 661-693.
- Chevalier, Judith, and Glenn Ellison, 1997, Risk taking by mutual funds as a response to incentives, *Journal of Political Economy* 105, 1167-1200.
- Cohen, Lauren, Karl Diether, and Christopher Malloy, 2013, Misvaluing innovation, *Review of Financial Studies* 26, 635-666.
- Cohn, Jonathan B., Zack Liu, and Malcolm I. Wardlaw, 2022, Count (and count-like) data in finance, *Journal of Financial Economics* 146, 529-551.
- Dechow, Patricia M., Richard G. Sloan, and Amy P. Sweeney, 1995, Detecting earnings management, *The Accounting Review* 70, 193-225.
- De Rassenfosse, Gaétan, William E. Griffiths, Adam B. Jaffe, and Elizabeth Webster, 2021, Low-quality patents in the eye of the beholder: Evidence from multiple examiners, *Journal of Law, Economics, and Organization* 37, 607-636.
- Dyer, Travis A., Stephen Glaeser, Mark H. Lang, and Caroline Sprecher, 2024, The effect of patent disclosure quality on innovation, *Journal of Accounting and Economics* 77, 101647.
- Ederer, Florian and Gustavo Manso, 2013, Is pay for performance detrimental to innovation? *Management Science* 59, 1496-1513.
- Eisenhardt, Kathleen M., 1989, Agency theory: An assessment and review, *Academy of Management Review* 14, 57-74.
- Erkens, David H., 2011, Do firms use time-vested stock-based pay to keep research and development investments secret?, *Journal of Accounting Research* 49, 861-894.
- Fitzgerald, Tristan, Benjamin Balsmeier, Lee Fleming, and Gustavo Manso, 2021, Innovation search strategy and predictable returns, *Management Science* 67, 1109-1137.
- Frakes, Michael D., and Melissa F. Wasserman, 2015, Does the US patent and trademark office grant too many bad patents: Evidence from a quasi-experiment, *Stan. L. Rev.* 67, 613.
- Ganglmair, Bernhard, W. Keith Robinson, and Michael Seeligson, 2022, The rise of process claims: Evidence from a century of US patents, Working Paper.
- Glaeser, Chloe Kim, Stephen Glaeser, and Eva Labro, 2023, Proximity and the management of innovation, *Management Science* 69, 3080-3099.

- Gompers, Paul, 1996, Grandstanding in the venture capital industry, *Journal of Financial Economics* 42, 133-156
- Hall, Bronwyn H., Adam B. Jaffe, and Manuel Trajtenberg, 2001, The NBER patent citation data file: Lessons, insights and methodological tools, National Bureau of Economic Research Cambridge, Print.
- Hall, Bronwyn H., Adam Jaffe, and Manuel Trajtenberg, 2005, Market value and patent citations, *RAND Journal of Economics*, 16-38.
- He, Jie Jack, and Xuan Tian, 2013, The dark side of analyst coverage: The case of innovation, *Journal of Financial Economics* 109, 856-878.
- Healy, Paul M., 1985, The effect of bonus schemes on accounting decisions, *Journal of Accounting and Economics* 7, 85–107.
- Healy, Paul M., and James Michael Wahlen, 1999, A review of the earnings management literature and its implications for standard setting, *Accounting Horizons* 13, 365-383.
- Hegde, Deepak, Alexander Ljungqvist, and Manav Raj, 2022, Quick or broad patents? Evidence from US startups, *Review of Financial Studies* 35, 2705-2742.
- Hertenstein, Julie H., and Marjorie B. Platt, 2000, Performance measures and management control in new product development, *Accounting Horizons* 14, 303–323.
- Hirshleifer, David, Angie Low, and Siew Hong Teoh, 2012, Are overconfident CEOs better innovators? *Journal of Finance* 67, 1457-1498.
- Hirshleifer, David, Po-Hsuan Hsu, and Dongmei Li, 2013, Innovative efficiency and stock returns, *Journal of Financial Economics* 107, 632-654.
- Hirshleifer, David, Po-Hsuan Hsu, and Dongmei Li, 2018, Innovative originality, profitability, and stock returns, *Review of Financial Studies* 31, 2553-2605.
- Holmstrom, Bengt, 1989, Agency costs and innovation, *Journal of Economic Behavior and Organization* 12, 305–327.
- Holmström, Bengt, 1999, Managerial incentive problems: A dynamic perspective, *Review of Economic Studies* 66, 169-182.
- Hsu, Po-Hsuan, Xuan Tian, and Yan Xu, 2014. Financial development and innovation: Cross country evidence, *Journal of Financial Economics* 112, 116-135.
- Jones, Jennifer J., 1991, Earnings management during import relief investigations, *Journal of Accounting Research* 29, 193-228.
- Kelly, Bryan, Dimitris Papanikolaou, Amit Seru, and Matt Taddy, 2021, Measuring technological innovation over the long run, *American Economic Review: Insights* 3, 303–320.
- Kogan, Leonid, Dimitris Papanikolaou, Amit Seru, and Noah Stoffman, 2017, Technological innovation, resource allocation, and growth, *Quarterly Journal of Economics* 132, 665-712.
- Lakonishok, Josef, 1991, Window dressing by pension fund managers, *American Economic Review* 81, 227-231.
- Lee, Joon Mahn, Jung Chul Park, and Timothy B. Folta, 2018, CEO career horizon, corporate governance, and real options: The role of economic short-termism, *Strategic Management Journal* 39, 2703-2725.
- Lemley, Mark A., and Bhaven Sampat, 2012, Examiner characteristics and patent office outcomes, *Review of Economics and Statistics* 94, 817-827.
- Lerner, Josh and Julie Wulf, 2007, Innovation and incentives: Evidence from corporate R&D, *Review of Economics and Statistics* 89, 634-644.
- Liu, Tong, Yifei Mao, and Xuan Tian, 2023, The role of human capital: Evidence from corporate innovation, *Journal of Empirical Finance* 74, 101435.

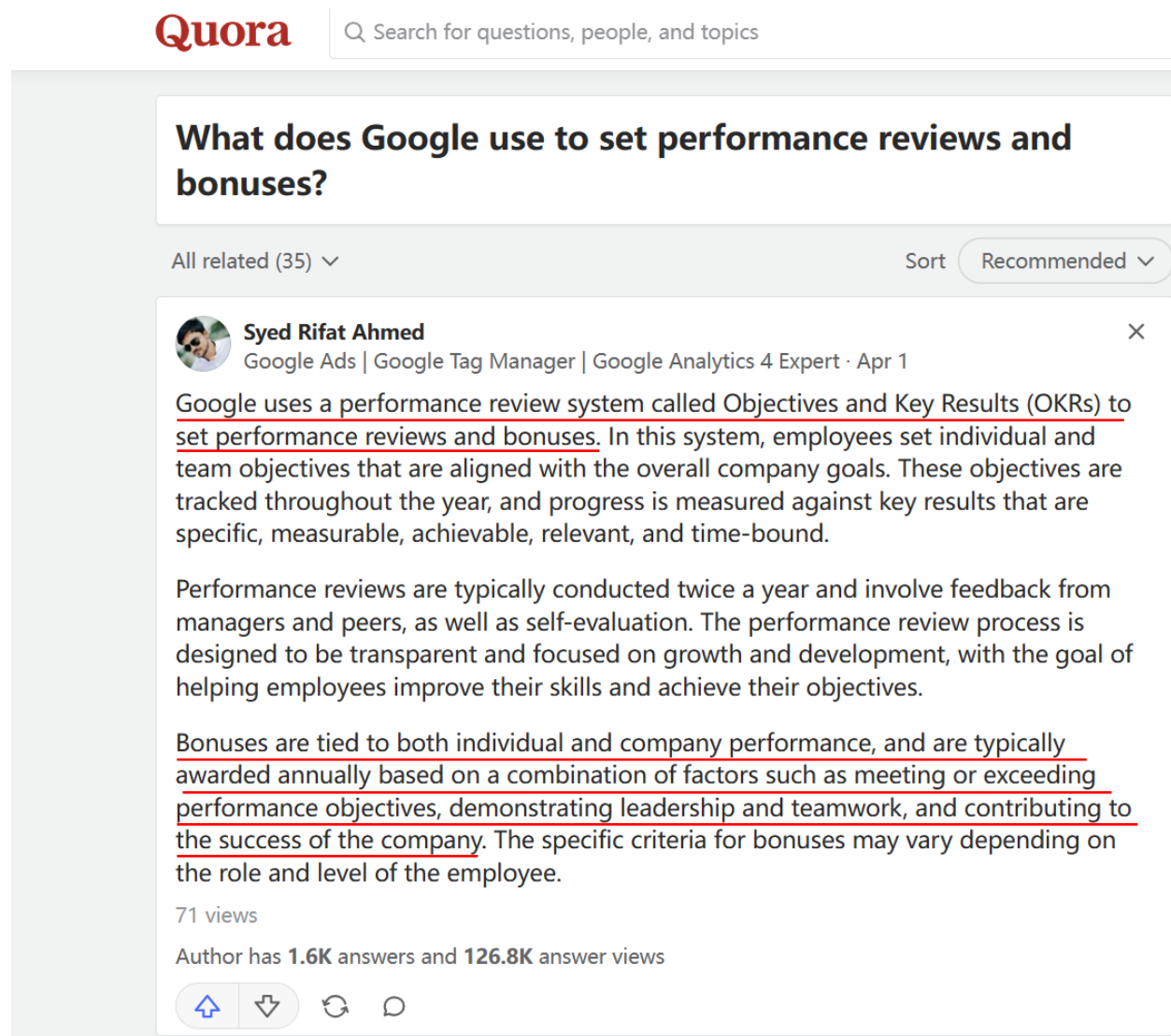
- Makri, Marianna, Peter J. Lane, and Luis R. Gomez-Mejia, 2006, CEO incentives, innovation, and performance in technology-intensive firms: A reconciliation of outcome and behavior-based incentive schemes, *Strategic Management Journal* 27, 1057-1080.
- Manso, Gustavo, 2011. Motivating innovation, *Journal of Finance* 66, 1823-1860.
- Mao, Connie X., Yueru Qin, Xuan Tian, and Chi Zhang, 2025, Does access to patent information help technological acquisitions? Evidence from patent library openings, *Journal of Accounting Research* 63, 903–950.
- Marco, Alan C., Joshua D. Sarnoff, and Charles A.W. deGrazia, 2019, Patent claims and patent scope, *Research Policy* 48, 103790.
- Marx, Matt, Deborah Strumsky, and Lee Fleming, 2009, Mobility, skills, and the Michigan non-compete experiment, *Management science* 55, 875–889.
- Musto, David K, 1999, Investment decisions depend on portfolio disclosures, *Journal of Finance* 54, 935-952.
- Pakes, Ariel, 1986, Patents as options: Some estimates of the value of holding European patent stocks, *Econometrica* 54, 755-784.
- Prendergast, Canice, and Lars Stole, 1996, Impetuous youngsters and jaded old-timers: Acquiring a reputation for learning, *Journal of Political Economy* 104, 1105-1134.
- Righi, Cesare, and Timothy Simcoe, 2019, Patent examiner specialization, *Research Policy* 48, 137-148.
- Roychowdhury, Sugata, 2006, Earnings Management Through Real Activities Manipulation, *Journal of Accounting and Economics* 42, 335-370.
- Shu, Tao, Xuan Tian, and Xintong Zhan, 2022, Patent quality, firm value, and investor underreaction: Evidence from patent examiner busyness, *Journal of Financial Economics* 143, 1043-1069.
- Singh, Jasjit, and Lee Fleming, 2010, Lone inventors as sources of breakthroughs: Myth or reality? *Management Science* 56, 41-56.
- Song, Jaeyong, Paul Almeida, and Geraldine Wu, 2003, Learning by hiring: When is mobility more likely to facilitate interfirm knowledge transfer? *Management Science* 49, 351-365.
- Tian, Xuan and Tracy Wang, 2014. Tolerance for failure and corporate innovation, *Review of Financial Studies*, 27, 211-225.
- Wabnegg, Markus, 2024, Fostering ambidexterity among R&D employees: The dilemma of performance measures and how to overcome it, *Management Accounting Research* 65, 100891.
- Zenger, Todd R., and Sergio G. Lazzarini, 2004, Compensating for innovation: Do small firms offer high-powered incentives that lure talent and motivate effort? *Managerial and Decision Economics* 25, 329–345.

Figure 1

Examples of Employee Performance Appraisal on Quora

This figure presents a webpage discussing employee performance appraisal at Google and Microsoft on Quora, a major social question-and-answer website. The discussion includes details about how and when the employee performance appraisal occurs in their respective companies. The page was downloaded on March 24, 2024.

Panel A: Discussion on Employee Performance Appraisal at Google



The screenshot shows a Quora page with the question "What does Google use to set performance reviews and bonuses?". The answer is by Syed Rifat Ahmed, a Google Ads | Google Tag Manager | Google Analytics 4 Expert, dated April 1. The answer text is as follows:

Google uses a performance review system called Objectives and Key Results (OKRs) to set performance reviews and bonuses. In this system, employees set individual and team objectives that are aligned with the overall company goals. These objectives are tracked throughout the year, and progress is measured against key results that are specific, measurable, achievable, relevant, and time-bound.

Performance reviews are typically conducted twice a year and involve feedback from managers and peers, as well as self-evaluation. The performance review process is designed to be transparent and focused on growth and development, with the goal of helping employees improve their skills and achieve their objectives.

Bonuses are tied to both individual and company performance, and are typically awarded annually based on a combination of factors such as meeting or exceeding performance objectives, demonstrating leadership and teamwork, and contributing to the success of the company. The specific criteria for bonuses may vary depending on the role and level of the employee.

71 views
Author has 1.6K answers and 126.8K answer views

At the bottom of the answer are icons for upvote, downvote, refresh, and comment.

Panel B: Discussion on Employee Performance Appraisal at Microsoft



Which month does microsoft do its annual performance review?



Yi Wang · [Follow](#)

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June. Fiscal year end.

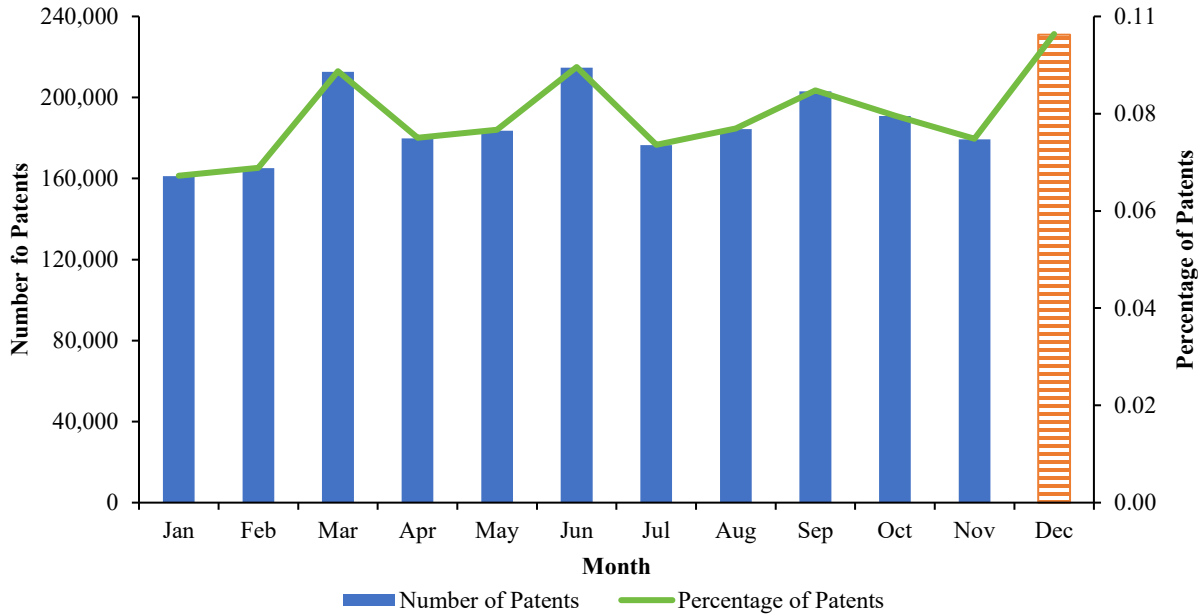


Figure 2

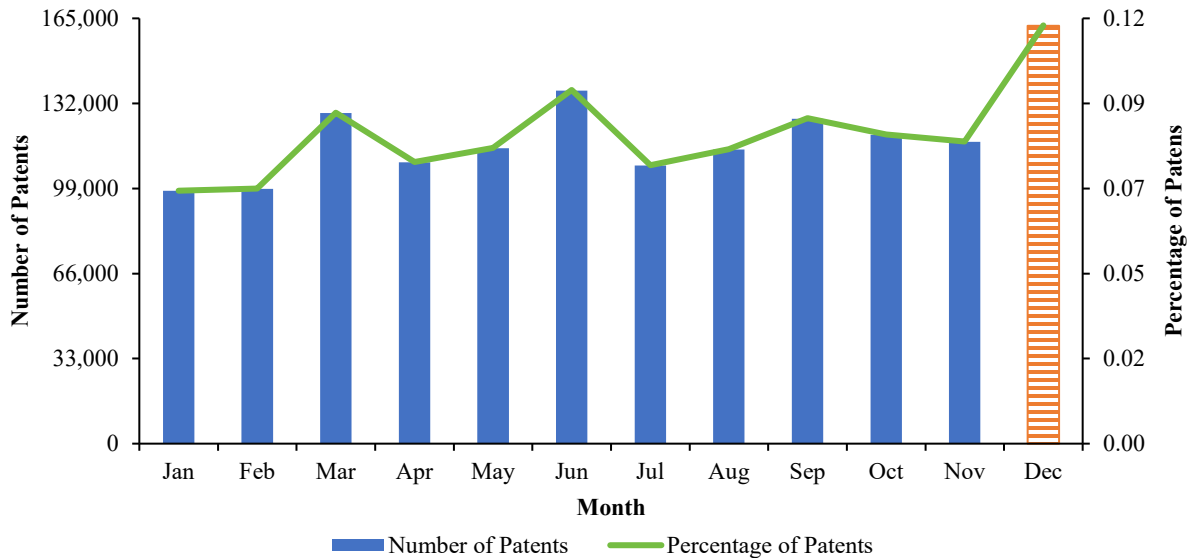
Patents Filed by US Public Firms Across Calendar Months

This figure presents patent filings by US public firms across calendar months. Panel A presents the number and percentage of patents filed by all publicly listed firms from 1980 to 2019. Panel B presents patents filed by firms whose fiscal year-ends in December. Panel C presents patents filed by firms with a fiscal year-end in a month other than December.

Panel A: Patents Filed by Calendar Months



Panel B: Subsample of Firms Whose Fiscal Year Ends in December



Panel C: Subsample of Firms Whose Fiscal Year Ends in Months Other Than December

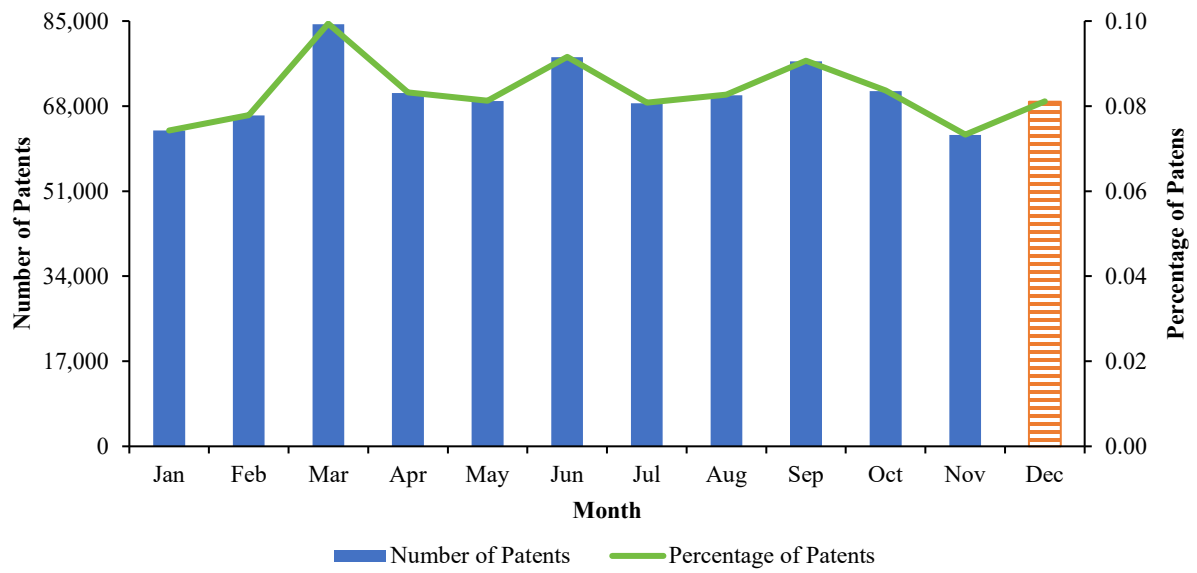
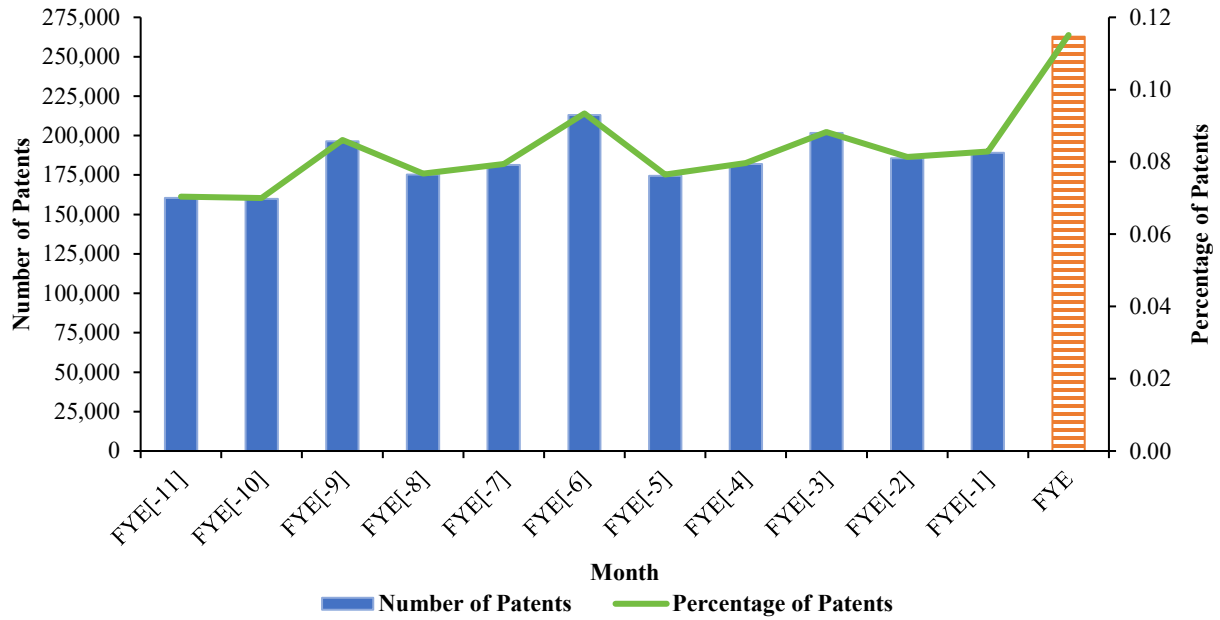


Figure 3
Patents Filed by US Public Firms Across Fiscal Months

This figure presents the number and percentage of patents filed by US public firms across fiscal months 1980 to 2019. Panel A presents results for the full sample, and Panel B presents results for the subsample of firms whose fiscal year ends in a month other than December. FYE presents the fiscal year-end month.

Panel A: Full Sample



Panel B: Subsample of Firms with Non-December Fiscal Year Ends

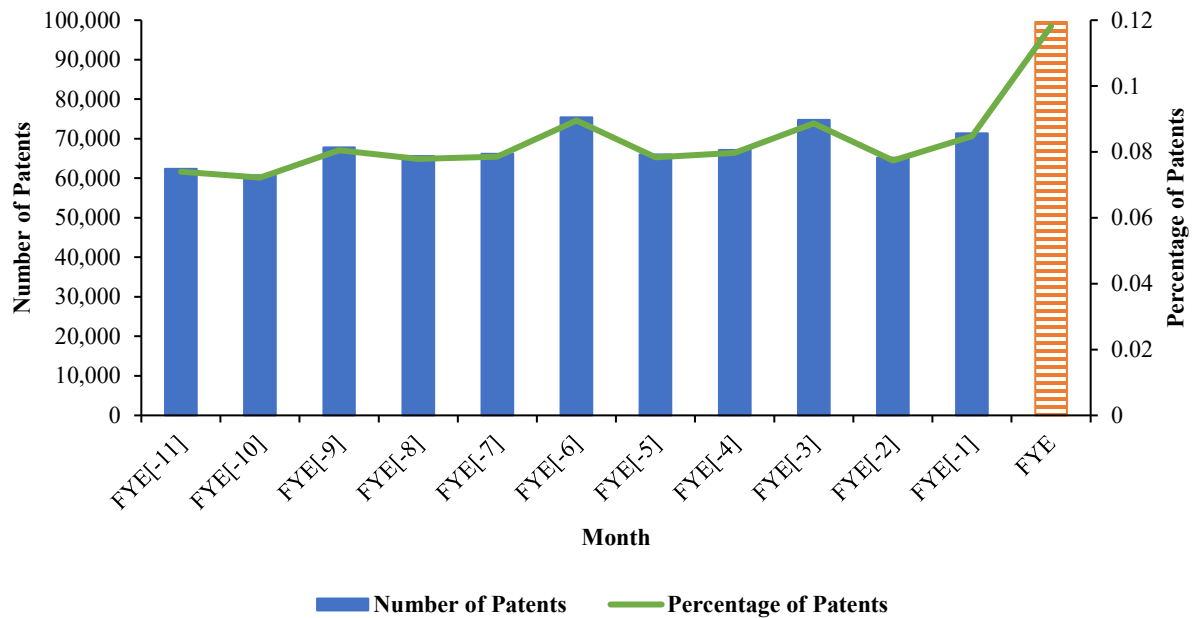


Figure 4

Differences in Patents Filed by US Public Firms Between Fiscal Year-End Month vs. Other Months

This figure presents the annual number and percentage differences between patents filed in the fiscal year-end month and other months from 1980 to 2019. The number difference is calculated as the number of patents filed in the FYE month minus the average number of patents filed in other months. The percentage difference is calculated by scaling the number difference with the number of patents filed in the FYE month.

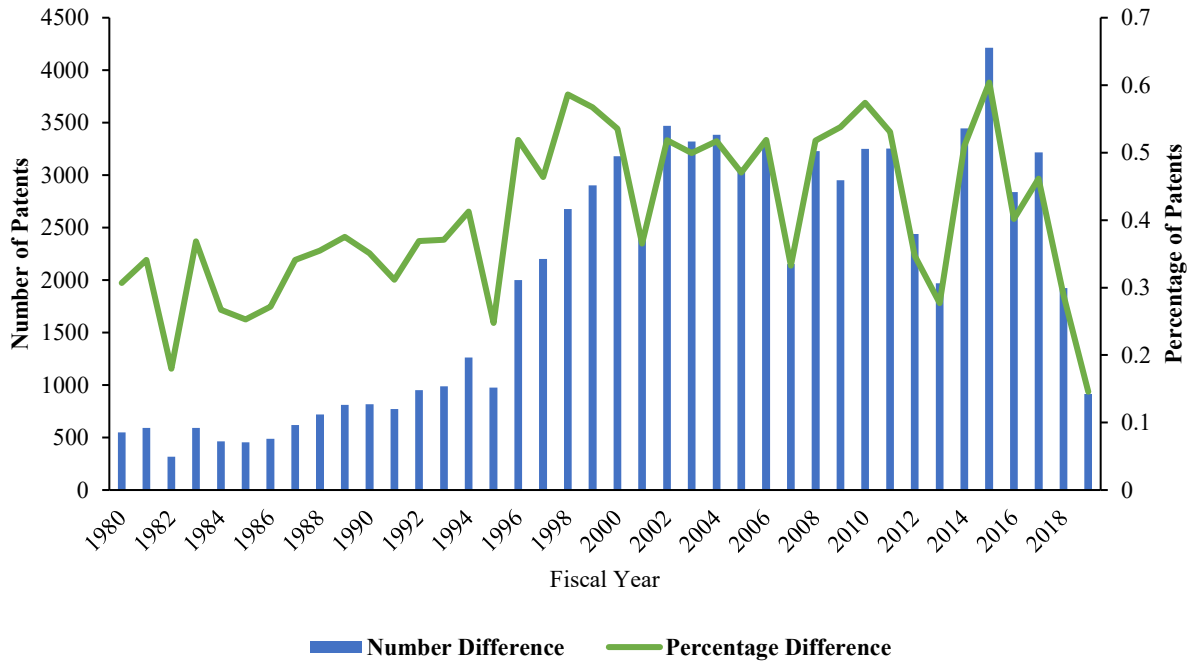


Figure 5
Patents Filed by Individuals

This figure presents the number and percentage of patents filed by individuals across different calendar months.

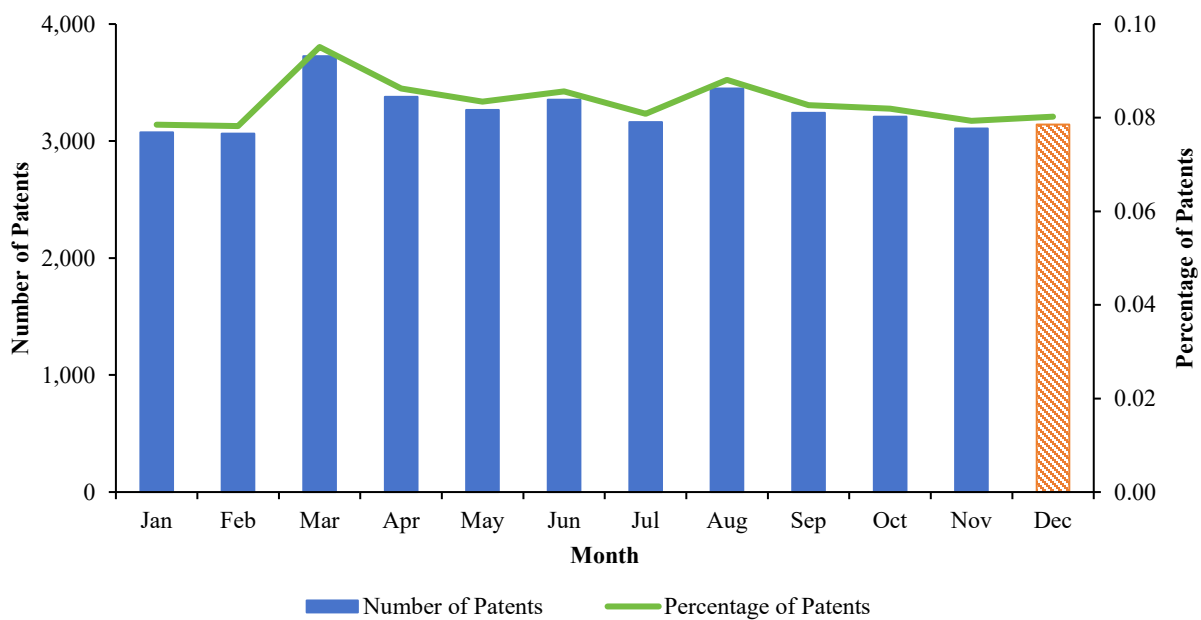
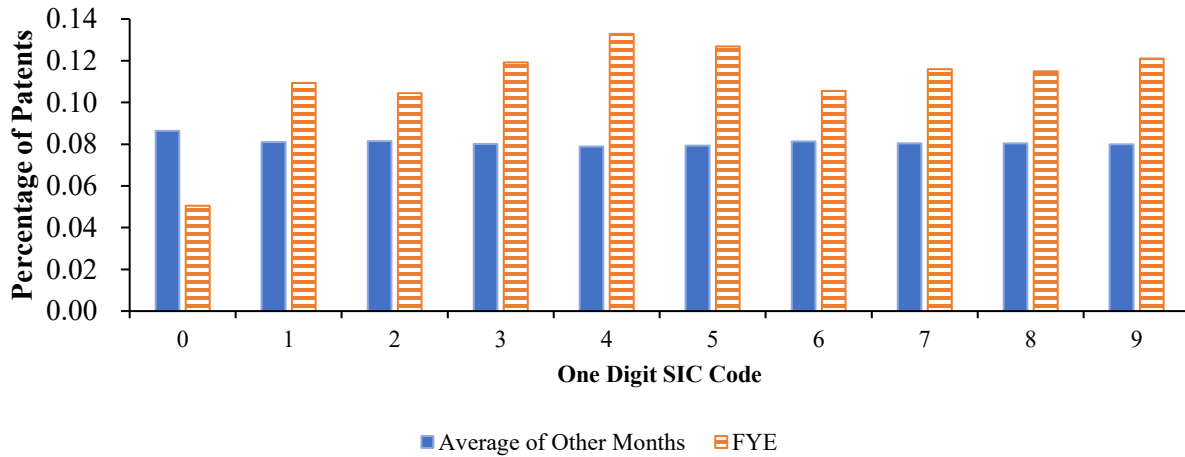


Figure 6

Innovation Management across Industries and Technologies

This figure presents innovation management across different industries and technology centers. Panel A presents the percentage of patents filed in the FYE month and the average of patents filed in other months for different industries. *FYE* represents the percentage of patents filed in the fiscal year-end month. *Average of Other Months* is the average percentage of patents filed in other months. We use the SIC one-digit code to categorize industries (0-Agriculture, Forestry, and Fishing, 1-Mining, 2-Construction, 3-Manufacturing, 4-Transportation, Communications, Electric, Gas, and Sanitary Services, 5-Wholesale Trade, 6-Retail Trade, 7-Finance, Insurance, and Real Estate, 8-Services, 9-Public Administration). Panel B presents the percentage of patents filed in the FYE month and the average of patents filed in other months for USPTO technology centers (1600-Biotechnology and Organic Chemistry, 1700-Chemical and Materials Engineering, 2100-Computer Architecture, Software, and Information Security, 2400-Computer Networks, Multiplex Communication, Video Distribution, and Security, 2600-Communications, 2800-Semiconductors, Electrical and Optical Systems and Components, 3600-Transportation, Construction, Electronic Commerce, Agriculture, National Security and License & Review, 3700-Mechanical Engineering, Manufacturing, Products).

Panel A: Industry



Panel B: Technology Center

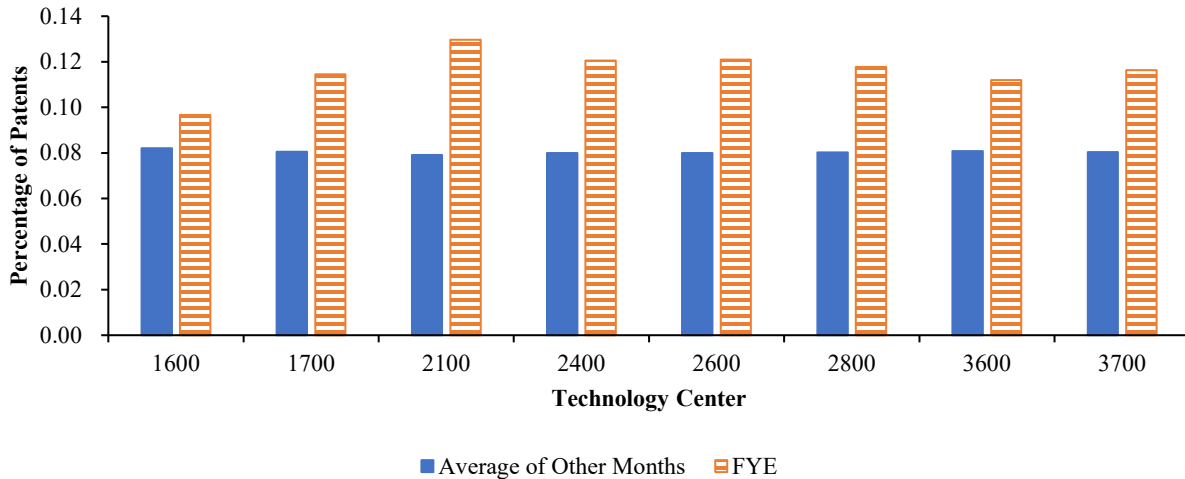
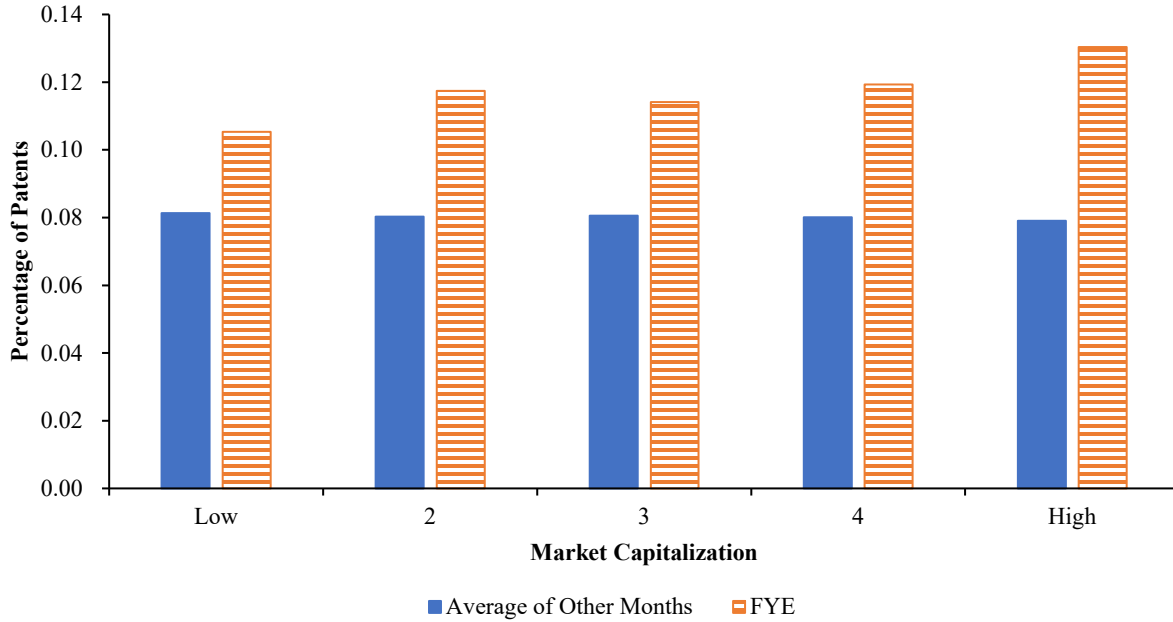


Figure 7

Innovation Management across Firm Size

This figure presents innovation management in different groups of firm size, which is proxied by market capitalization in Panel A and total assets in Panel B. For each year, we divide firms into five groups based on the firm size measures. *FYE* represents the percentage of patents filed in the fiscal year-end month. *Average of Other Months* is the average percentage of patents filed in other months.

Panel A: Market Capitalization



Panel B: Total Assets

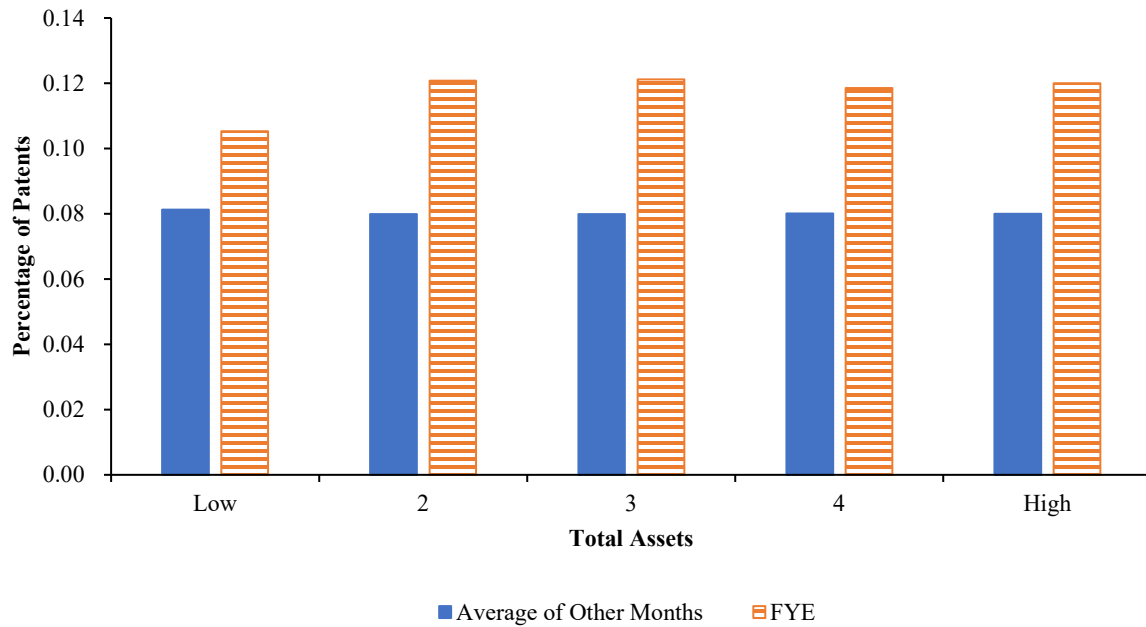


Figure 8
Grant Rate of Patent Filings by Month

This figure presents the grant rate of patent filings in each calendar month. The sample includes all patent applications filed with USPTO from 1980 to 2019. The patent grant rate for a month is calculated as the number of patents filed in that month that were eventually granted, scaled by the total number of patent applications filed in that month.

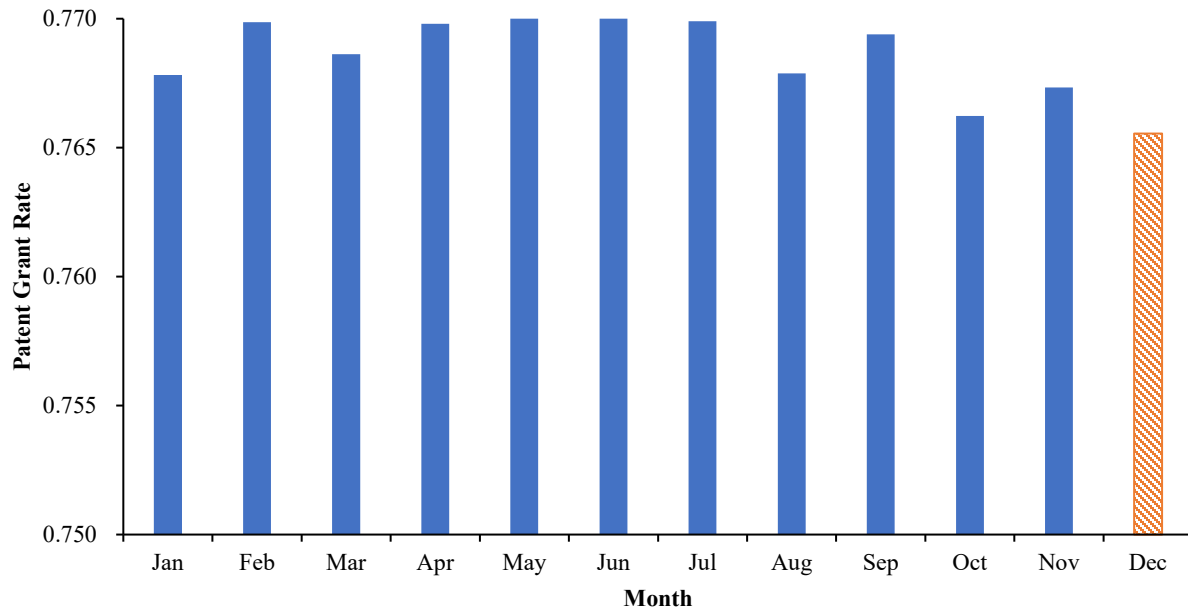
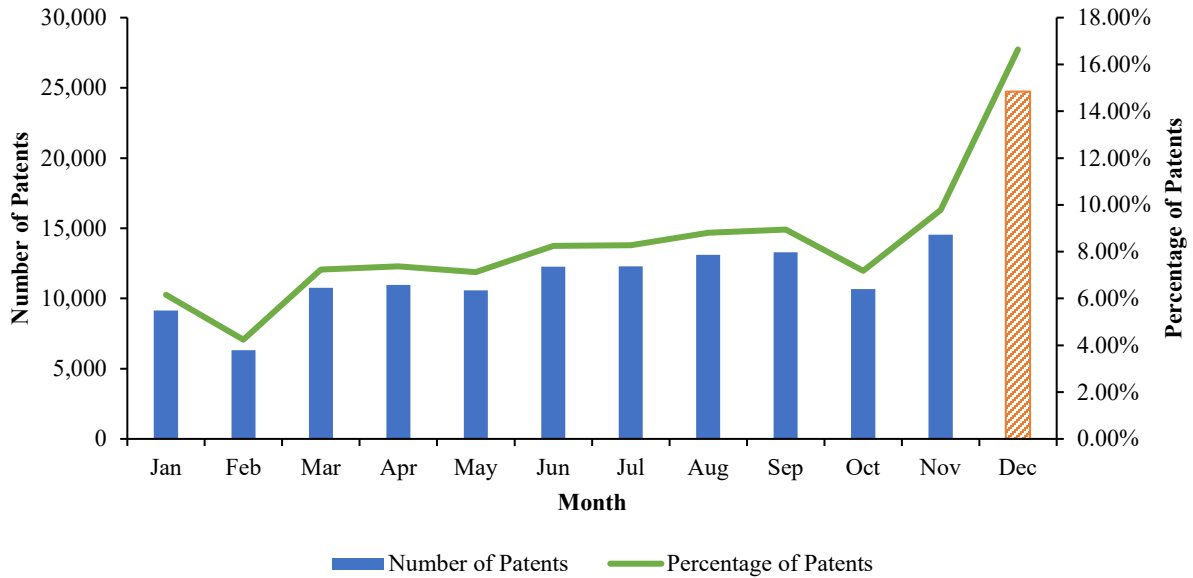


Figure 9
Innovation Management: International Evidence

This figure presents innovation management globally. Panel A presents the number and percentage of patents filed with the China National Intellectual Property Administration by Chinese public firms across different months between 2004 and 2023. The fiscal year end of all public firms in China is in December. Panel B presents the number of patents filed with the USPTO by applicants from foreign countries or regions including Australia, Germany, Switzerland, UK, Finland, France, Taiwan, Japan, China, and Korea from 1980 to 2019. The y-axis shows the percentage difference between patents filed in the FYE month and the average patent filings in other months across countries.

Panel A: Patents filed by Chinese Listed Firms with CNIPA in Different Months



Panel B: Percentage Difference between FYE and Non-FYE Patent Filings: International Evidence

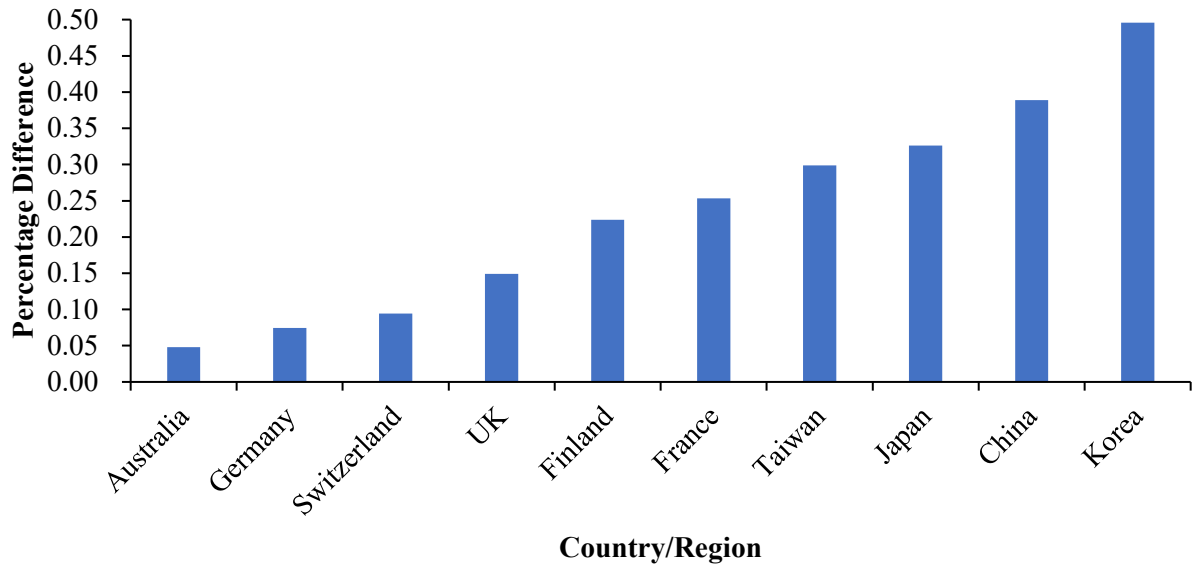
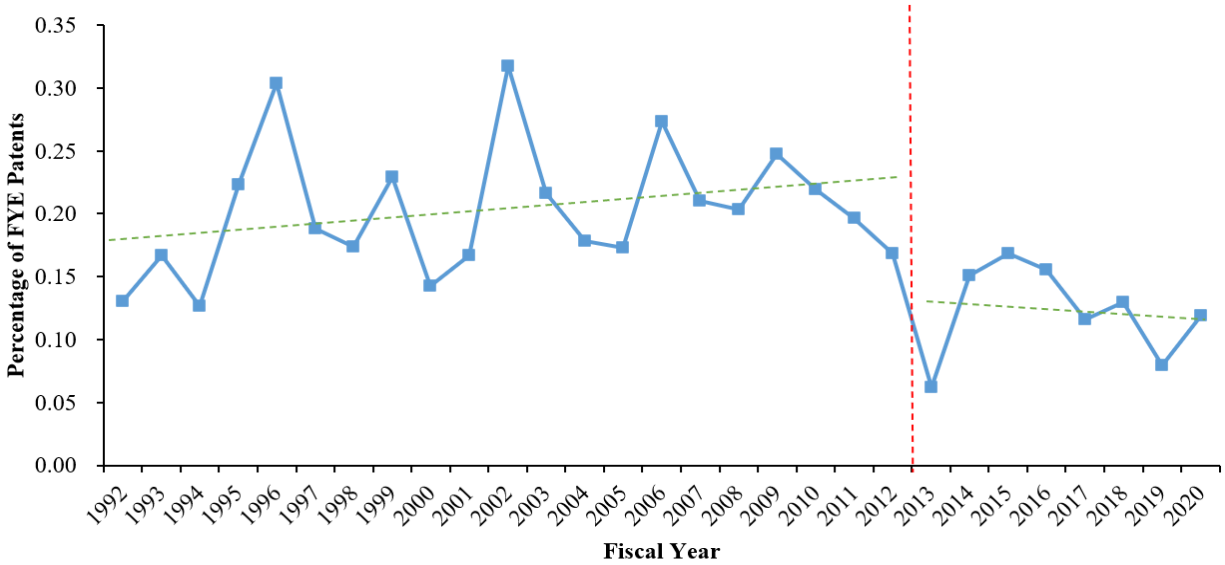


Figure 10

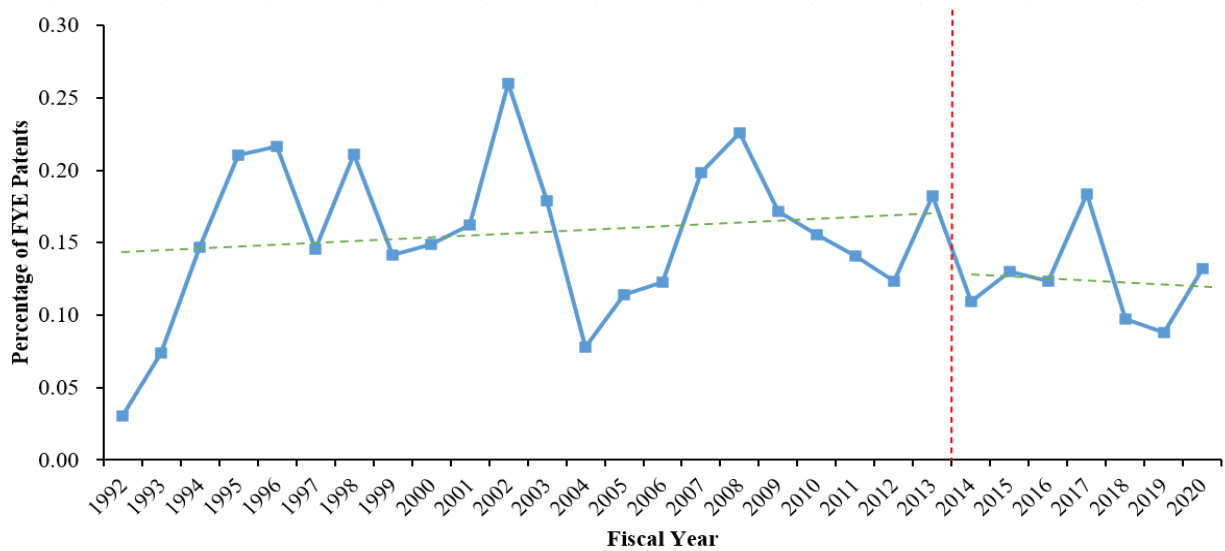
Abandonment of Annual Performance Reviews and Innovation Management: Case Studies

This figure presents the percentage of FYE patents for firms that announced the abandonment of traditional annual performance review or a transition to a continuous, real-time feedback-based evaluation systems in Panels A to D, and randomly selected firms without the announcement in Panels E to H. The vertical red dashed line in Panels A to D represents the announcement time. The x-axis represents the fiscal year, and the y-axis represents the percentage of FYE patents, which is the number of patents filed in the FYE month scaled by the total patents filed in that year. The sample period is from 1992 to 2020.

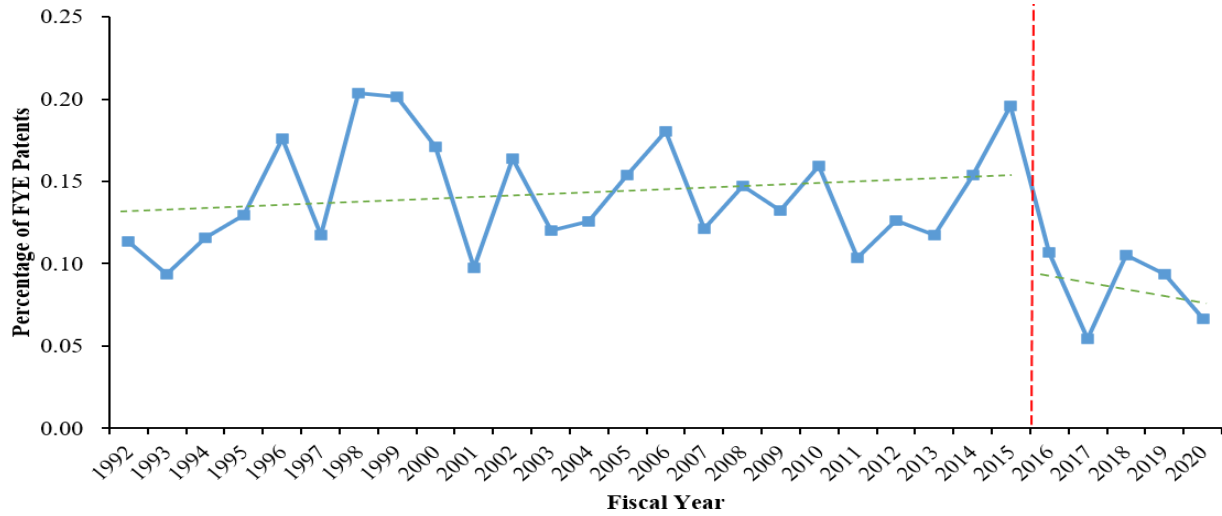
Panel A: Medtronic PLC



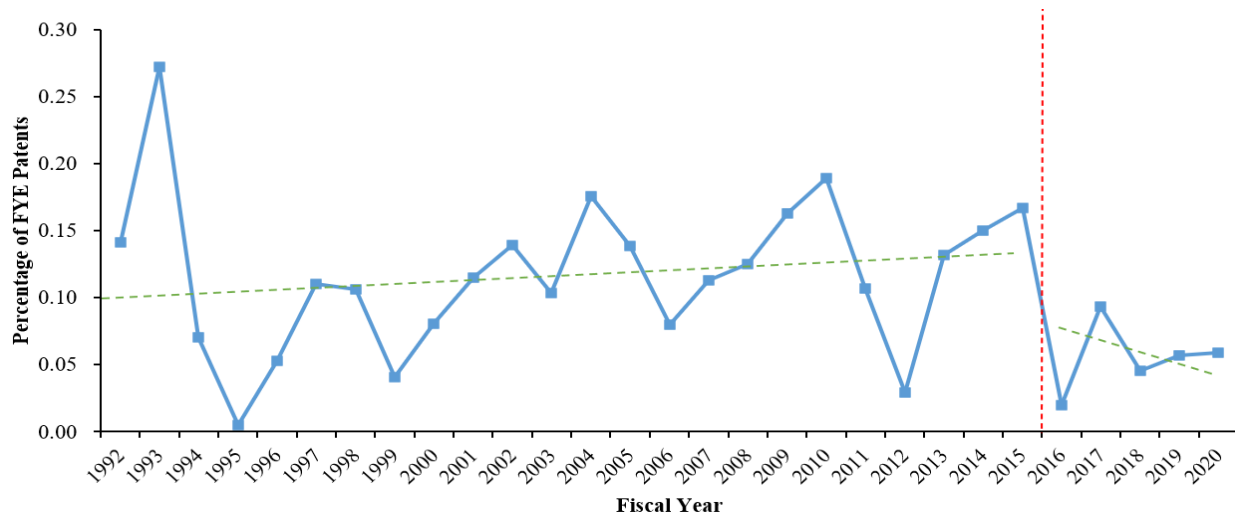
Panel B: Microsoft Corporation



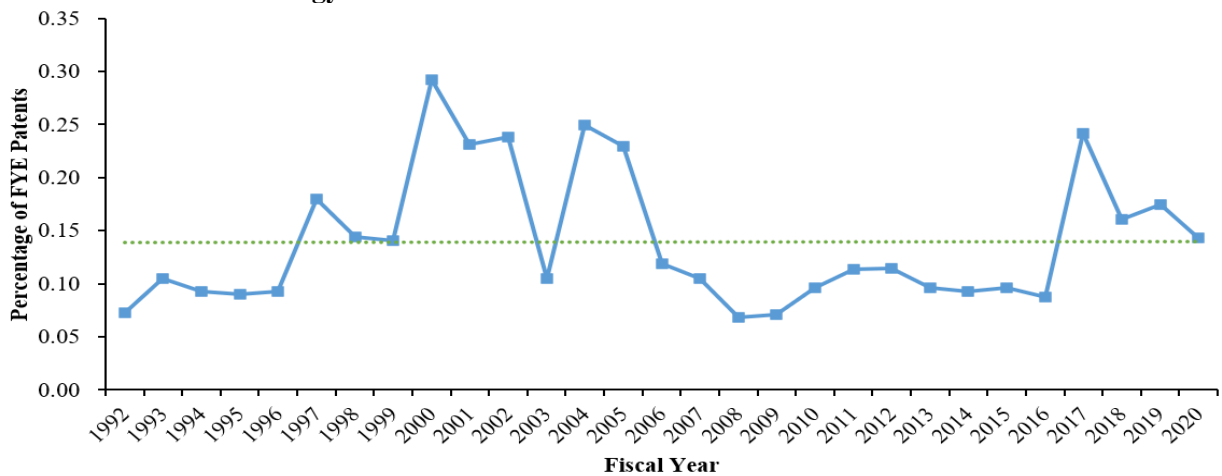
Panel C: General Electric



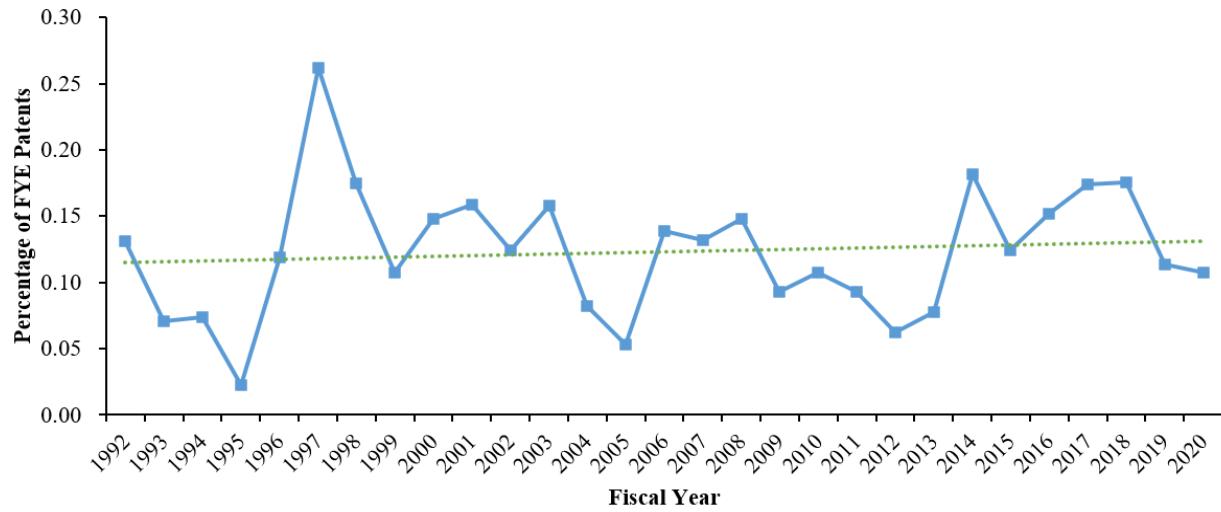
Panel D: Eli Lilly



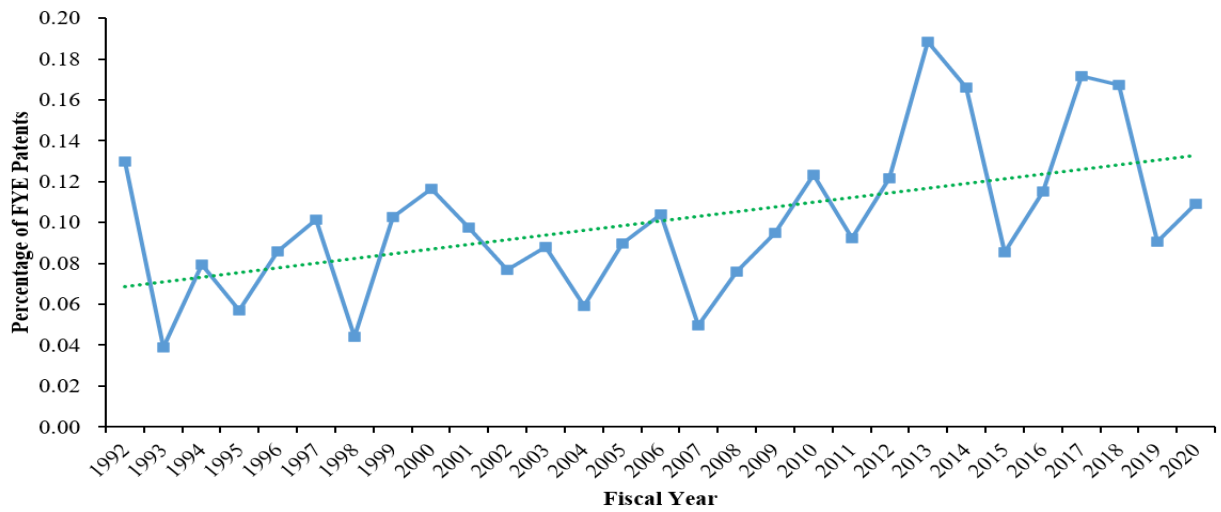
Panel E: Micron Technology



Panel F: Texas Industries Inc



Panel G: Halliburton Company



Panel H: Sony Group

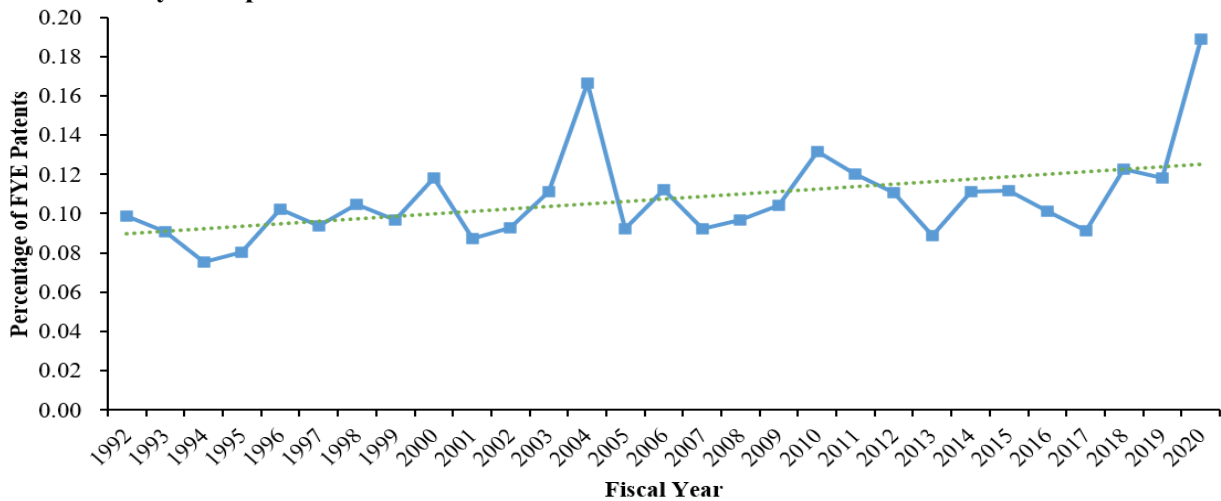
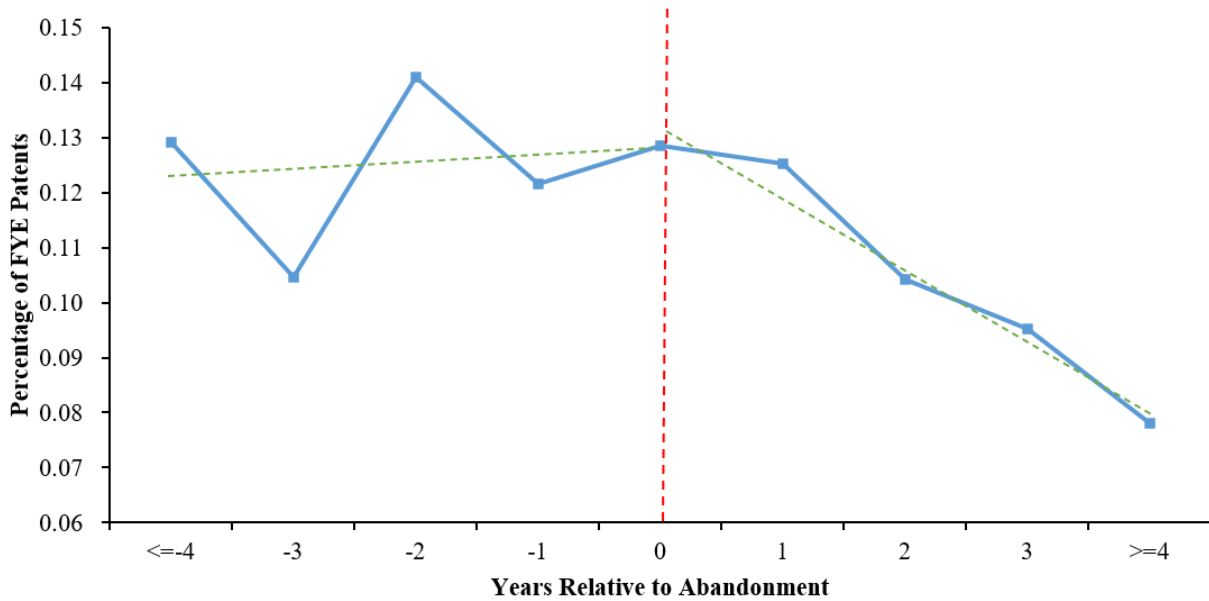


Figure 11

Abandonment of Annual Performance Reviews and Innovation Management: S&P 500 Firms

This figure presents the percentage of FYE patents for 14 S&P 500 firms that announced the abandonment of traditional annual performance reviews or the transition to a more continuous, real-time feedback-based evaluation system (Panel A), and for other S&P 500 firms without such announcements (Panel B). The vertical red dashed line in Panel A indicates the announcement year. In Panel A, the x-axis represents years relative to the announcement, and the y-axis represents the percentage of FYE patents, defined as the number of patents filed in the FYE month divided by the firm's total patents filed in that fiscal year. In Panel B, the x-axis represents the fiscal year, and the y-axis represents the percentage of FYE patents. The sample period is 1980–2019.

Panel A: S&P 500 Firms with Abandonment Announcements



Panel B: S&P 500 Firms without Abandonment Announcements

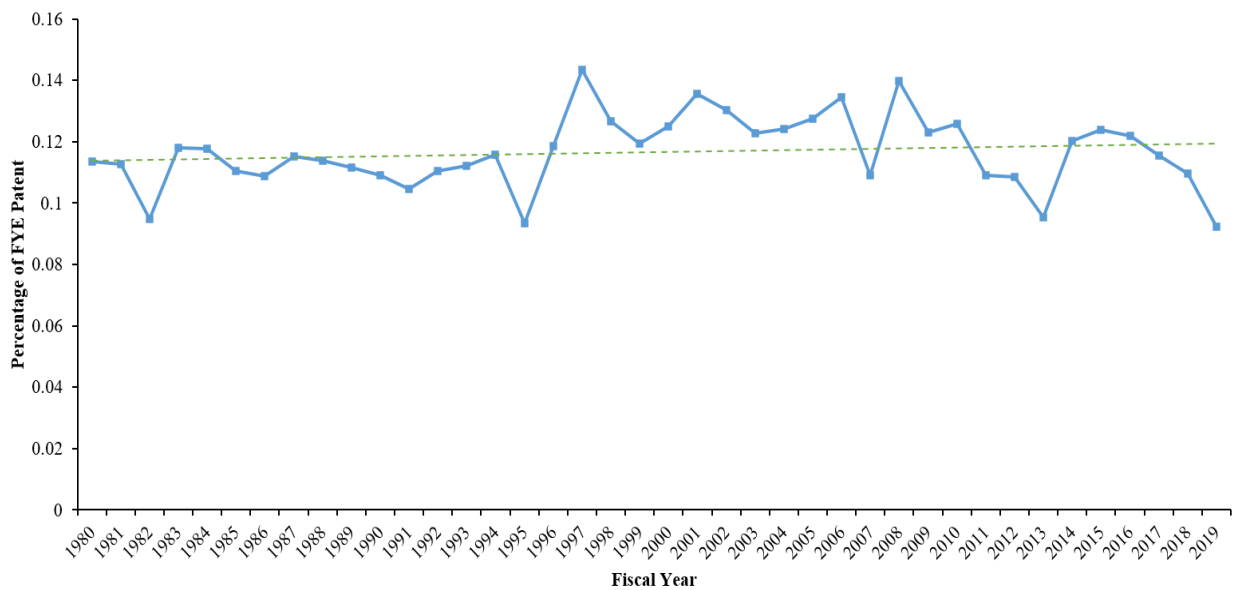


Table 1
Summary Statistics

This table reports summary statistics for patent-, firm-month, firm-year, and inventor-level variables from 1980 to 2019. *FYE Patent* is a dummy variable that equals one if a patent is filed in the fiscal year-end month, and zero otherwise. *IM Patent* is a dummy variable that equals one if its average inventor FYE tendency is above the median of the FYE patents in the previous year, and zero otherwise. Inventor FYE tendency is defined as the proportion of the inventor's FYE patent filings among all her patent filings in the year. Average inventor FYE tendency is calculated as the average inventor FYE tendency for the patent. *Non-IM Patent* are the remaining patents filed in the fiscal year-end month. *Adjusted Citation* is the truncation-adjusted future citations. *Originality* is the number of unique technology subclasses cited by the focal patent. *No Citation* is a dummy variable that equals one if the patent receives no future citation. *Breakthrough Patent* is a dummy variable that equals one if the forward citation count is in the top 5% of all patents in the same application year and technology class. *#Claims* is the total number of claims in the patent. *#Independent Claims* is the number of independent claims in the patent. *#Dependent Claims* is the number of dependent claims in the patent. *ln(Number of Words)* is the natural logarithm of total number of words in the description section of a patent. *Gunning Fog* is the Fog index of the description section. *Automated Reading* is the Automated Readability index of the description section. *Flesch Reading* is the Flesch Reading index of the description. *#Figures* is the total number of figures in the patent text. *#Sheets* is the total number of sheets in the patent text. *Trailing_3Qtrs* is a dummy variable equal to one if the total number of patents filed by an inventor in the first three quarters of the year is lower than the first three quarters of the previous year, and zero otherwise. *Trailing_11M* is a dummy variable equal to one if the total number of patents filed by an inventor in the first eleven months of the year is lower than the first eleven months of the previous year, and zero otherwise. *Working Years* is the number of years an inventor has worked. *Total Patents Filed* is the total number of patents filed by the inventor up to the current year. *Average Adjusted Citation* is the average truncation adjusted citation for patents filed by the inventor up to the current year. *Average Originality* is the average originality of patents filed by the inventor up to the current year. *Total Breakthrough Patents* is the total number of breakthrough patents filed by the inventor up to the current year. *%Inventor IM Patent* is the number of IM patents filed, scaled by the total number of patents filed by an inventor in a year. *Turnover_{t+1}* is a dummy variable that equals one if an inventor moves to another company in the next year. *OCF_{t+1}* is the operating cash flow scaled by the total assets in the next year. *ROA_{t+1}* is the net income scaled by total assets in the next year. *Size* is the logarithm of total assets. *Firm Age* is the number of years since the year of the company's IPO. *Cash* is cash scaled by total assets. *Leverage* is total debt scaled by total equity. *BM* is the book to market ratio. *CAPX* is capital expenditures scaled by total assets. *PPE* is net property, plant, and equipment scaled by total assets. *CEO Unexercised Options* is the total unexercised stock options scaled by total compensation in that year. *CEO Career Horizon* is the estimated time remaining until a CEO's departure due to retirement or termination. *%IM* is the number of IM patents scaled by the total patents filed in a year. *#Patent_1_3M_{t+1}* is total number of a firm's patent filings in the following year during months 1–3. *#Patent_4_6M_{t+1}* is total number of a firm's patent filings in the following year during months 4–6. *#Patent_7_9M_{t+1}* is total number of a firm's patent filings in the following year during months 7–9. *ln(Patent Stock)* is the natural logarithm of total patents filed up to the current year. *#Patents* is the total number of patents filed in the fiscal month. *Stock Return* is the monthly stock return. *BM* is the book to market ratio. *ln(ME)* is the natural logarithm of the market capitalization. *Ret [-1]* is the return of the month *t-1*. *Ret [-12, -2]* is the buy-and-hold return from month *t-2* to *t-12*. *Asset Growth* is change in total assets, scaled by lagged total assets. *ROE* is return on equity.

Variables	Obs.	Mean	SD	P10	P25	P50	P75	P90
Patent Level Variables								
FYE Patent	2,259,890	0.11	0.32	0.00	0.00	0.00	0.00	1.00
IM Patent	2,259,890	0.06	0.23	0.00	0.00	0.00	0.00	0.00
Non-IM Patent	2,259,890	0.06	0.24	0.00	0.00	0.00	0.00	0.00
Citation	2,259,890	12.98	26.53	0.00	0.00	3.00	13.00	34.00
Adjusted Citation	2,259,890	0.91	1.56	0.00	0.00	0.38	1.03	2.31
Originality	2,069,535	9.16	13.74	1.00	3.00	5.00	10.00	19.00
No Citation	2,069,535	0.24	0.43	0.00	0.00	0.00	0.00	1.00
Breakthrough	2,069,535	0.05	0.21	0.00	0.00	0.00	0.00	0.00
#Claims	1,585,404	16.90	11.12	5.00	9.00	15.00	21.00	30.00
#Independent Claims	1,585,404	2.94	2.00	1.00	2.00	3.00	4.00	5.00
#Dependent Claims	1,585,404	13.93	10.16	3.00	7.00	13.00	18.00	26.00
ln(Number of Words)	2,097,253	8.33	0.82	7.28	7.78	8.33	8.87	9.37
Gunning Fog	2,097,253	18.36	2.66	15.11	16.59	18.23	19.96	21.73
Automated Readability	2,097,253	15.72	3.06	12.06	13.73	15.53	17.46	19.53
Flesch Reading	2,097,253	35.36	10.51	21.92	28.38	35.4	42.45	48.81
#Figures	2,104,266	12.05	11.41	3.00	5.00	9.00	15.00	24.00
#Sheets	2,104,266	8.61	7.95	2.00	4.00	6.00	11.00	17.00
Patent-Inventor Level Variables								
Trailing_3Qtrs	4,791,747	0.26	0.44	0.00	0.00	0.00	1.00	1.00
Trailing_11M	4,791,747	0.25	0.43	0.00	0.00	0.00	0.00	1.00
Working Years	4,765,441	8.82	6.96	2.00	3.00	7.00	13.00	19.00
Total Patents Filed	4,765,441	22.42	40.45	1.00	3.00	8.00	22.00	55.00
Average Adjusted Citation	4,765,441	1.22	1.32	0.23	0.48	0.85	1.46	2.51
Average Originality	4,765,441	9.01	11.56	1.67	3.25	5.67	9.65	18.42
Total Breakthrough Patent	4,765,441	1.52	3.73	0.00	0.00	0.00	1.00	4.00
Inventor Level Variables								
%Inventor IM Patent	5,311,228	0.01	0.11	0.00	0.00	0.00	0.00	0.00
Turnover _{t+1}	5,311,228	0.05	0.21	0.00	0.00	0.00	0.00	0.00
Firm-Year Level Variables								
OCF _{t+1}	59,662	0.00	0.24	-0.25	-0.01	0.07	0.13	0.18
ROA _{t+1}	59,662	-0.07	0.30	-0.39	-0.08	0.03	0.08	0.12
Proportion IM	59,662	0.07	0.14	0.00	0.00	0.03	0.08	0.17
ln(Patent Stock)	59,662	2.93	2.19	0.00	1.10	2.64	4.25	6.08
Size	59,662	5.83	2.35	2.92	4.06	5.63	7.48	9.16
Firm Age	59,662	21.08	15.54	5.00	8.00	16.00	30.00	45.00
Cash	59,662	0.24	0.25	0.01	0.04	0.14	0.37	0.66
Leverage	59,662	0.53	1.40	0.00	0.01	0.24	0.70	1.44
BM	59,662	0.54	0.48	0.11	0.23	0.43	0.72	1.11
R&D	59,662	0.09	0.15	0.00	0.00	0.03	0.11	0.24
CAPX	59,662	0.05	0.05	0.01	0.02	0.04	0.06	0.10
PPE	59,662	0.22	0.19	0.04	0.08	0.17	0.32	0.50
CEO Horizon	21,055	-0.42	3.18	-4.58	-2.00	-0.09	1.67	3.50
CEO LT Incentives	21,055	1.97	4.98	0.00	0.00	0.12	1.57	5.06
%IM	87,843	0.03	0.13	0.00	0.00	0.00	0.00	0.08
#Patent_1_3M _{t+1}	87,843	5.53	39.36	0.00	0.00	0.00	1.00	6.00
#Patent_4_6M _{t+1}	87,843	6.07	42.65	0.00	0.00	0.00	1.00	6.00
#Patent_7_9M _{t+1}	87,843	5.92	41.86	0.00	0.00	0.00	1.00	6.00

Firm-Month Level Variables								
# Patents	586,680	3.85	19.96	0.00	0.00	0.00	1.00	6.00
Stock Return	618,883	0.01	0.15	-0.13	-0.06	0.01	0.07	0.16
BM	618,883	0.58	1.06	0.12	0.24	0.44	0.73	1.14
Ln(ME)	618,883	13.4	2.06	10.79	11.88	13.30	14.78	16.2
Ret[-1]	618,883	0.01	0.14	-0.13	-0.06	0.01	0.07	0.15
Ret[-12,-2]	618,883	0.13	0.59	-0.40	-0.17	0.07	0.31	0.64
Asset Growth	618,883	0.23	1.10	-0.09	-0.01	0.07	0.20	0.50

Table 2
Number of Patents Filed in the Fiscal Year-End Month

This table examines whether there is innovation management in terms of a surge in patent filings in the fiscal year-end month. The sample period covers the firm-months from 1980 to 2019. The dependent variable is the total number of patents filed in the fiscal month. The main independent variable is *FYE*, which is a dummy variable that equals one for the fiscal year-end month, and zero otherwise. Columns (1) and (2) use OLS regression, while Columns (3) and (4) use Poisson regression. Control variables including Market Cap and ln(Patent Stock) are defined in Appendix A. We control for firm and year fixed effects in all models. T-statistics using robust standard errors adjusted for heteroscedasticity and clustered at the firm level are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Dep. Var.	#Patents			
	OLS		Poisson	
	(1)	(2)	(3)	(4)
FYE	1.637*** (7.25)	1.301*** (6.58)	0.365*** (11.53)	0.315*** (10.25)
Market Cap		0.721*** (2.71)		0.135*** (4.32)
ln(Patent Stock)		2.410*** (6.43)		0.621*** (18.04)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Adj. R ² / Pseudo R ²	0.614	0.620	0.803	0.826
Observations	562,498	558,784	562,498	558,594

Table 3
Quality of Patents Filed in the Fiscal Year-End Month

This table examines the quality of patents filed in the fiscal year-end month relative to patents that filed in other months. Panel A presents the results of Citations. The dependent variable is *Raw Citation* in Column (1), and *Adjusted Citation* in Column (2). The main independent variable is *FYE Patent*, which is a dummy variable that equals one if a patent is filed in the fiscal year-end month, and zero otherwise. Panel B is similar to Panel A except we use other patent quality measures instead of citations. The dependent variable is *Originality* in Column (1), *No Citation* in Column (2), and *Breakthrough Patent* in Column (3). We control for the filing year, art unit, and firm fixed effects. T-statistics using robust standard errors adjusted for heteroscedasticity and clustered at the firm level are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Citations

Dep. Var.	Raw Citation (1)	Adjusted Citation (2)
FYE Patent	-0.523*** (-6.86)	-0.034*** (-5.37)
Filing Year FE	Yes	Yes
Firm FE	Yes	Yes
Art Unit FE	Yes	Yes
Adj. R ²	0.288	0.079
Observations	2,258,764	2,258,764

Panel B: Other Patent Quality Measures

Dep. Var.	Originality (1)	No Citation (2)	Breakthrough Patent (3)
FYE Patent	-0.191*** (-2.86)	0.013*** (9.38)	-0.002*** (-3.67)
Filing Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Art Unit FE	Yes	Yes	Yes
Adj. R ²	0.229	0.320	0.044
Observations	2,068,395	2,068,395	2,068,395

Table 4
Patent Quality of the Patents associated with Innovation Management

This table examines the quality of patents associated with innovation management. We categorize FYE patents into two groups: IM patents (innovation management) and non-IM patents based on FYE tendency. FYE tendency is the proportion of the inventor's FYE patent filings among all her patent filings in the year. The average FYE tendency for a patent is calculated as the average FYE tendency of all inventors who file that patent. *IM Patent* is a dummy variable that equals one if its average inventor FYE tendency is above the median of the FYE patents in the previous year, and zero otherwise. The remaining FYE patent are classified as non-IM patent. Panel A presents the quality of IM patents. The dependent variables are *Raw Citation* in Column (1), and *Adjusted Citation* in Column (2). The independent variable is *IM Patent*. In Panel B, we directly compare the quality differences between IM patents and patents filed in other months by excluding non-IM patents. Panel C presents the results of quality differences between non-IM patents and patents filed in other months, excluding IM patents. We control for patent filing year, art unit, and firm fixed effects. T-statistics using robust standard errors adjusted for heteroscedasticity and clustered at the firm level are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Full Sample

Dep. Var.	Raw Citation	Adjusted Citation
	(1)	(2)
IM Patent	-0.902*** (-6.86)	-0.072*** (-10.34)
Filing Year FE	Yes	Yes
Firm FE	Yes	Yes
Art Unit FE	Yes	Yes
Adj. R ²	0.288	0.079
Observations	2,258,472	2,258,472

Panel B: IM Patents vs. Patents Filed in Other Months

Dep. Var.	Raw Citation	Adjusted Citation
	(1)	(2)
IM Patent	-0.909*** (-6.90)	-0.071*** (-9.98)
Filing Year FE	Yes	Yes
Firm FE	Yes	Yes
Art Unit FE	Yes	Yes
Adj. R ²	0.289	0.079
Observations	2,124,696	2,124,696

Panel C: Non-IM Patents vs. Patents Filed in Other Months

Dep. Var.	Raw Citation	Adjusted Citation
	(1)	(2)
Non-IM Patent	-0.168* (-1.80)	0.002 (0.20)
Filing Year FE	Yes	Yes
Firm FE	Yes	Yes
Art Unit FE	Yes	Yes
Adj. R ²	0.290	0.079
Observations	2,133,136	2,133,136

Table 5

Other Patent Quality Measures of the Patents associated with Innovation Management

This table examines the quality of IM and Non-IM Patents using other patent quality measures including *Originality*, *No Citation* and *Breakthrough Patent*. We categorize FYE patent into two groups: IM patents (opportunistic) and non-IM patents (non-opportunistic) based on FYE tendency. FYE tendency is the proportion of the inventor's FYE patent filings among all her patent filings in the year. The average FYE tendency for a patent is calculated as the average FYE tendency of all inventors who file that patent. *IM Patent* is a dummy variable that equals one if its average inventor FYE tendency is above the median of the FYE patents in the previous year, and zero otherwise. The remaining FYE patent are classified as non-IM patents. Panel A presents the quality of IM patents. The dependent variables are *Originality* in Column (1), *No Citation* in Column (2) and *Breakthrough Patent* in Column (3). The independent variable is *IM Patent*. In Panel B, we directly compare the quality differences between IM patents and patents filed in other months by excluding non-IM patents. In Panel C, we directly compare the quality differences between non-IM patents and patents filed in other months by excluding IM patents. We control for patent filing year, art unit, and firm fixed effects. T-statistics using robust standard errors adjusted for heteroscedasticity and clustered at the firm level are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Full Sample

Dep. Var.	Originality	No Citation	Breakthrough Patent
	(1)	(2)	(3)
IM Patent	-0.657*** (-6.24)	0.022*** (11.74)	-0.006*** (-7.19)
Filing Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Art Unit FE	Yes	Yes	Yes
Adj. R ²	0.229	0.320	0.044
Observations	2,068,292	2,068,292	2,068,292

Panel B: IM Patents vs. Patents Filed in Other Months

Dep. Var.	Originality	No Citation	Breakthrough Patent
	(1)	(2)	(3)
IM Patent	-0.645*** (-6.16)	0.022*** (11.67)	-0.006*** (-6.97)
Filing Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Art Unit FE	Yes	Yes	Yes
Adj. R ²	0.228	0.321	0.044
Observations	1,945,544	1,945,544	1,945,544

Panel C: Non-IM Patents vs. Patents Filed in Other Months

Dep. Var.	Originality	No Citation	Breakthrough Patent
	(1)	(2)	(3)
Non-IM Patent	0.224** (2.28)	0.004*** (2.83)	0.001 (0.61)
Filing Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Art Unit FE	Yes	Yes	Yes
Adj. R ²	0.231	0.320	0.045
Observations	1,953,350	1,953,350	1,953,350

Table 6
Innovation Management and Subsequent Patent Filings

This table examines whether innovation-management is associated with reduced patent filings in the subsequent months. The independent variable, % *IM*, is the number of IM patents a firm files in a year divided by the firm's total patents filed that year. The dependent variables are the firm's total number of patent filings in the following year during months 1–3 (*#Patent_1_3M_{t+1}*) in Column (1), months 4–6 (*#Patent_4_6M_{t+1}*) in Column (2), and months 7–9 (*#Patent_7_9M_{t+1}*) in Column (3). Control variables including ln(Patent Stock), Size, Firm Age, Cash, Leverage, BM, R&D, CAPX and PPE are defined in Appendix A. We control firm and year fixed effects in all models. T-statistics using robust standard errors adjusted for heteroscedasticity and clustered at the firm level are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Dep. Var.	#Patent 1 3M _{t+1}	#Patent 4 6M _{t+1}	#Patent 7 9M _{t+1}
	(1)	(2)	(3)
%IM	-1.245** (-2.44)	-0.931* (-1.77)	-0.665 (-1.29)
ln(Patent Stock)	4.928*** (6.60)	5.402*** (6.37)	5.310*** (6.15)
Size	0.547 (0.76)	0.793 (1.10)	0.747 (1.00)
Firm Age	-0.002 (-0.02)	0.022 (0.30)	0.036 (0.47)
Cash	1.367 (1.21)	1.360 (1.16)	1.122 (0.92)
Leverage	0.184 (1.20)	0.161 (1.03)	0.180 (1.08)
BM	-0.373 (-1.18)	-0.453 (-1.51)	-0.494 (-1.60)
R&D	-0.531 (-0.29)	-0.278 (-0.15)	-0.102 (-0.06)
CAPX	3.015 (1.33)	3.278 (1.32)	3.312 (1.27)
PPE	-3.221 (-0.77)	-3.361 (-0.77)	-4.042 (-0.92)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Adj. R ²	0.612	0.623	0.621
Observations	87,758	87,758	87,758

Table 7

Disclosure Quality of Patents Associated with Innovation Management

This table examines the disclosure quality of patents associated with innovation management. Panel A presents the results of the length of the description section of a patent. The dependent variable is the natural logarithm of total number of words in the description section. The independent variable is *IM Patent*, which is a dummy variable that equals one if its average inventor FYE tendency is above the median of the FYE patents in the previous year, and zero otherwise. Panel B presents the results of readability of the description section. The dependent variables are the *Gunning Fog* index in Column (1), *Automated Readability* index in Column (2) and *Flesch Reading* index in Column (3). For the Gunning Fog and Automated Readability, the larger the index number, the harder the text is to read. However, for the Flesch Reading, the smaller the index number, the harder the text is to read. To make all three measures indicate readability in the same direction, we multiply the Flesch Reading by -1. Panel C presents the results of number of figures and sheets in the patent text. Panel D presents the results of number of claims. The dependent variable is total number of claims in Column (1), total number of independent claims in Column (2), and total number of dependent claims in Column (3). We control for the patent filing year, art unit, and firm fixed effects. T-statistics using robust standard errors adjusted for heteroscedasticity and clustered at the firm level are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Length of Description

Dep. Var.	ln(Number of Words)	
	(1)	(2)
IM Patent	-0.018** (-2.07)	-0.021*** (-3.16)
Filing Year FE	Yes	Yes
Firm FE	Yes	Yes
Art Unit FE	No	Yes
Adj. R ²	0.326	0.365
Observations	2,095,850	2,095,821

Panel B: Text Readability of Description

Dep. Var.	Gunning Fog	Automated Readability	Flesch Reading
	(1)	(2)	(3)
IM Patent	0.041** (2.27)	0.069*** (2.65)	0.129** (2.16)
Filing Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Art Unit FE	Yes	Yes	Yes
Adj. R ²	0.190	0.198	0.256
Observations	2,095,821	2,095,821	2,095,821

Panel C: Figures and Sheets

Dep. Var.	#Figures	#Sheets
	(1)	(2)
IM Patent	-0.397*** (-3.21)	-0.197** (-2.17)
Filing Year FE	Yes	Yes
Firm FE	Yes	Yes
Art Unit FE	Yes	Yes
Adj. R ²	0.193	0.215
Observations	2,102,845	2,102,845

Panel D: Number of Claims

Dep. Var.	# of Claims	# of Independent Claims	# of Dependent Claims
	(1)	(2)	(3)
IM Patent	-0.160** (-2.33)	-0.041*** (-3.38)	-0.112* (-1.86)
Filing Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Art Unit FE	Yes	Yes	Yes
Adj. R ²	0.167	0.138	0.157
Observations	1,583,948	1,583,948	1,583,948

Table 8
Inventor Characteristics and Innovation Management

This table examines the relationship between inventor characteristics and innovation management. In Panel A, the dependent variable is *IM Patent*, which is a dummy variable for patent associated with innovation management. The independent variable is *Trailing_3Qtrs* in Column (1) and *Trailing_11M* in Column (2). *Trailing_3Qtrs* is a dummy variable that equals one if the total patents filed by an inventor in the first three quarters of this year are less than the total number of patents filed in the first three quarters of the previous year, and zero otherwise. *Trailing_11M* is similarly defined as *Trailing_3Qtrs*, except it equals one if the total patents filed in the first eleven months of this year are less than those filed in the previous year. Panel B presents the results of inventor's working experience. The independent variable is *Working Years_{t-1}* in Columns (1), and *Total Patents Filed_{t-1}* in Columns (2). *Working Years_{t-1}* is the number of years an inventor has worked up to the previous year. *Total Patents Filed_{t-1}* is the total number of patents filed by the inventor up to the previous year. Panel C presents the results of inventor's past performance. The independent variable is the *Average Adjusted Citation_{t-1}* in Column (1), and *Average Originality_{t-1}* in Column (2), and *Total Breakthrough Patent_{t-1}* in Column (3). *Average Adjusted Citation_{t-1}* is the average truncation adjusted citation for patents filed by the inventor up to the previous year. *Average Originality* is the average originality of patents filed by the inventor up to the previous year. *Total Breakthrough Patents* is the total number of breakthrough patents filed by the inventor up to the previous year. We control for filing year, art unit, and firm fixed effects. T-statistics using robust standard errors adjusted for heteroscedasticity and clustered at the firm level are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Trailing in Early Months

Dep. Var.	IM Patent	
	(1)	(2)
Trailing_3Qtrs	0.058*** (18.02)	
Trailing_11M		0.120*** (16.90)
Filing Year FE	Yes	Yes
Firm FE	Yes	Yes
Art Unit FE	Yes	Yes
Adj. R ²	0.036	0.084
Observations	4,791,390	4,791,390

Panel B: Working Experience

Dep. Var.	IM Patent	
	(1)	(2)
Working Years _{t-1}	-0.0001*** (-2.74)	
Total Patents Filed _{t-1}		-0.0003*** (-8.51)
Filing Year FE	Yes	Yes
Firm FE	Yes	Yes
Art Unit FE	Yes	Yes
Adj. R ²	0.020	0.022
Observations	4,764,482	4,764,482

Panel C: Past Performance

Dep. Var.	IM Patent		
	(1)	(2)	(3)
Average Adjusted Citation _{t-1}	-0.0025*** (-8.18)		
Average Originality _{t-1}		-0.0003*** (-7.28)	
Total Breakthrough Patent _{t-1}			-0.0022*** (-10.49)
Filing Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Art Unit FE	Yes	Yes	Yes
Adj. R ²	0.021	0.021	0.022
Observations	4,764,482	4,764,482	4,764,482

Table 9

Innovation Management and Future Inventor Turnovers

This table examines the relationship between inventors' innovation management and their future turnovers. The dependent variable is Turnover_{t+1} to Turnover_{t+8} in Columns (1) to (8), respectively. Turnover_{t+1} is a dummy variable that equals one if an inventor moves to another company in the next year, and zero otherwise. Turnover_{t+2} to Turnover_{t+8} are similarly defined, except they equal one if an inventor moves to another company in the next two to eight years. The independent variable is *%Inventor IM Patent*, which is defined as the number of IM patents filed, scaled by the total number of patents filed by an inventor in a year. We control for filing year and inventor fixed effects. T-statistics using robust standard errors adjusted for heteroscedasticity and clustered at the inventor level are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Dep. Var.	Turnover _{t+1}	Turnover _{t+2}	Turnover _{t+3}	Turnover _{t+4}	Turnover _{t+5}	Turnover _{t+6}	Turnover _{t+7}	Turnover _{t+8}
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
%Inventor IM Patent	-0.006*** (-7.99)	-0.005*** (-6.14)	-0.005*** (-5.63)	-0.002** (-2.13)	0.000 (0.34)	0.000 (0.05)	0.004** (2.43)	0.006*** (3.78)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Inventor FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R ²	0.006	0.009	0.006	0.004	0.002	0.001	0.000	0.001
Observations	5,240,595	4,603,024	4,043,162	3,556,058	3,130,908	2,757,979	2,428,736	2,135,839

Table 10**Abandonment of Annual Performance Reviews and Innovation Management: S&P 500 Firms**

This table presents DiD results on the effect of S&P 500 firms' abandonment of annual performance appraisals, or their transition to a more continuous, real-time feedback-based evaluation system, on firms' innovation management. The dependent variable is % IM Patent, defined as the number of IM patents filed scaled by a firm's total patent filings in a year. The independent variable is Firm Abandonment, a dummy variable equal to one for firms that announced the abandonment of traditional annual performance reviews or a transition to a more continuous, real-time feedback-based evaluation system in and after the announcement year, and zero otherwise. Control variables including ln(Patent Stock), Size, Firm Age, Cash, Leverage, BM, R&D, CAPX, and PPE are defined in Appendix A. We include firm and year fixed effects in all models. t-statistics based on robust standard errors adjusted for heteroscedasticity and clustered at the firm level are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Dep. Var.	% IM Patent	
	(1)	(2)
Firm Abandonment	-0.019** (-2.33)	-0.021** (-2.54)
ln(Patent Stock)		0.003** (2.10)
Size		0.002 (1.02)
Firm Age		0.000 (0.27)
Cash		-0.009 (-0.74)
Leverage		0.001 (1.65)
BM		0.074 (1.28)
R&D		-0.003 (-0.69)
CAPX		0.022 (0.60)
PPE		0.024 (1.40)
Firm FE	Yes	Yes
Year FE	Yes	Yes
Adj. R ²	0.129	0.131
Observations	12,700	12,700

Table 11
Innovation Management and CEO Incentives

This table examines the relationship between CEO characteristics and innovation management. Panel A presents the results of CEO's long-term incentives. The dependent variable is %IM, which is defined as number of IM patents scaled by total patents filed in the year. The independent variable is *CEO Career Horizon* in Columns (1) and (2), and *CEO Unexercised Option* in Columns (3) and (4). The *CEO Career Horizon* is the estimated time remaining until a CEO's departure due to retirement or termination. *CEO Unexercised Option* is the value of the unexercised option scaled by total compensation. Panel B presents the results of CEO performance pressure. The independent variable is stock return in the previous year in Column (1), stock return in the current year in Column (2), ROA in the previous year in Column (3), and ROA in the current year in Column (4). Control variables including ln(Patent Stock), Size, Firm Age, Cash, Leverage, BM, R&D, CAPX and PPE in the previous year are defined in Appendix A. We control firm and year fixed effects in all models. T-statistics using robust standard errors adjusted for heteroscedasticity and clustered at the firm level are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: CEO Long-Term Incentives

Dep. Var.	%IM			
	(1)	(2)	(3)	(4)
CEO Career Horizon	-0.0612 (-1.41)	-0.0540 (-1.25)		
CEO Unexercised Option			-0.0226 (-1.05)	-0.0193 (-0.92)
ln(Patent Stock _{t-1})		1.2686*** (4.56)		1.2744*** (4.59)
Size _{t-1}		0.1652 (0.79)		0.1516 (0.72)
Firm Age _{t-1}		-0.0281 (-0.54)		-0.0307 (-0.58)
Cash _{t-1}		0.1458 (0.15)		0.1887 (0.20)
Leverage _{t-1}		-0.4146 (-0.49)		-0.4496 (-0.53)
BM _{t-1}		0.0893 (0.28)		0.0775 (0.24)
R&D _{t-1}		0.6758 (0.57)		0.6538 (0.55)
CAPX _{t-1}		7.3142* (1.69)		7.4289* (1.72)
PPE _{t-1}		-2.3893 (-1.18)		-2.4188 (-1.19)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Adj. R ²	0.045	0.046	0.045	0.046
Observations	20,804	20,804	20,804	20,804

Panel B: CEO Performance Pressure

Dep. Var.	%IM			
	(1)	(2)	(3)	(4)
Stock Return _{t-1}	-0.0763 (-0.61)			
Stock Return _t		0.1659 (1.13)		
ROA _{t-1}			0.3944 (1.51)	
ROA _t				0.0706 (0.25)
ln(Patent Stock _{t-1})	1.2820*** (4.61)	1.2726*** (4.57)	1.2789*** (4.60)	1.2806*** (4.61)
Size _{t-1}	0.1467 (0.71)	0.2176 (1.01)	0.1352 (0.64)	0.1597 (0.76)
Firm Age _{t-1}	-0.0319 (-0.60)	-0.0298 (-0.57)	-0.0342 (-0.64)	-0.0312 (-0.59)
Cash _{t-1}	0.1732 (0.18)	0.2219 (0.23)	0.1085 (0.11)	0.1673 (0.17)
Leverage _{t-1}	-0.4530 (-0.54)	-0.5398 (-0.64)	-0.2916 (-0.35)	-0.4218 (-0.50)
BM _{t-1}	0.0419 (0.13)	-0.0145 (-0.04)	0.1145 (0.36)	0.1000 (0.31)
R&D _{t-1}	0.5794 (0.49)	0.6017 (0.50)	1.3418 (1.01)	0.7174 (0.59)
CAPX _{t-1}	7.1002 (1.64)	7.4771* (1.72)	7.3482* (1.70)	7.3316* (1.70)
PPE _{t-1}	-2.3786 (-1.17)	-2.4142 (-1.18)	-2.3766 (-1.17)	-2.4011 (-1.17)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Adj. R ²	0.044	0.044	0.044	0.044
Observations	20,804	20,804	20,804	20,804

Table 12
IM Patents and Future Financial Performance

This table examines the effect of IM patents on a firm's future financial performance based on innovation intensity. We separate firms into high and low innovation intensity based on the total number of patents filed by the firm up to the current year. A firm is classified as innovation intensity firm if its total patent filings up to the current year is above the yearly sample median. Panel A presents the results of high innovation intensity firms. The dependent variable is *OCF* in year $t+1$ in Column (1), *OCF* in year $t+2$ in Column (2), *ROA* in year $t+1$ in Column (3) and *ROA* in year $t+2$ in Column (4). The main independent variable is *Proportion IM*, which is defined as the cumulative number of IM patents up to the current year scaled by the cumulative number of total patents filed by the firm up to the current year. Control variables including $\ln(\text{Patent Stock})$, Size, Firm Age, Cash, Leverage, BM, R&D, CAPX and PPE are defined in Appendix A. We control for firm and year fixed effects in all models. Panel B is similar to Panel A, except it presents the results of low innovation intensity firms. T-statistics using robust standard errors adjusted for heteroscedasticity and clustered at the firm level are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: High Innovation Intensity Firms

Dep. Var.	OCF _{t+1}	OCF _{t+2}	ROA _{t+1}	ROA _{t+2}
	(1)	(2)	(3)	(4)
Proportion IM	-0.096** (-2.46)	-0.073* (-1.93)	-0.127** (-2.20)	-0.092* (-1.92)
$\ln(\text{Patent Stock})$	-0.002 (-0.85)	-0.001 (-0.44)	0.002 (0.63)	0.005 (1.32)
Size	0.005 (1.27)	-0.001 (-0.22)	-0.008* (-1.73)	-0.020*** (-3.85)
Firm Age	0.000 (0.36)	0.000 (0.31)	0.001 (0.66)	-0.000 (-0.02)
Cash	-0.146*** (-9.28)	-0.138*** (-8.17)	-0.024 (-1.10)	-0.100*** (-4.32)
Leverage	-0.001 (-0.74)	-0.000 (-0.22)	-0.000 (-0.17)	0.001 (0.81)
BM	-0.027*** (-7.55)	-0.023*** (-5.95)	-0.090*** (-16.37)	-0.046*** (-8.75)
R&D	-0.409*** (-12.12)	-0.238*** (-6.94)	-0.498*** (-12.36)	-0.262*** (-5.97)
CAPX	0.002 (0.05)	0.050 (1.14)	-0.053 (-1.00)	-0.045 (-0.79)
PPE	0.058*** (2.71)	0.063*** (2.85)	0.043 (1.58)	0.054* (1.90)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Adj. R ²	0.688	0.677	0.603	0.592
Observations	30,004	27,668	30,004	27,668

Panel B: Low Innovation Intensity Firms

Dep. Var.	OCF_{t+1}	OCF_{t+2}	ROA_{t+1}	ROA_{t+2}
	(1)	(2)	(3)	(4)
Proportion IM	-0.026 (-1.39)	-0.010 (-0.54)	-0.013 (-0.55)	-0.011 (-0.41)
ln(Patent Stock)	-0.002 (-0.55)	-0.000 (-0.10)	0.006 (1.41)	0.004 (0.87)
Size	0.005 (1.57)	-0.000 (-0.13)	-0.016*** (-3.55)	-0.022*** (-4.76)
Firm Age	-0.000 (-0.12)	-0.001 (-0.31)	0.001 (0.52)	0.000 (0.28)
Cash	-0.224*** (-14.35)	-0.165*** (-9.62)	-0.069*** (-3.22)	-0.112*** (-4.90)
Leverage	-0.001 (-0.65)	-0.001 (-1.11)	-0.000 (-0.19)	0.000 (0.09)
BM	-0.018*** (-5.63)	-0.019*** (-6.00)	-0.085*** (-16.52)	-0.037*** (-8.20)
R&D	-0.416*** (-13.75)	-0.163*** (-4.57)	-0.437*** (-11.34)	-0.153*** (-3.47)
CAPX	-0.116*** (-3.19)	-0.059* (-1.69)	-0.059 (-1.21)	-0.059 (-1.17)
PPE	-0.043* (-1.86)	-0.005 (-0.21)	-0.019 (-0.56)	-0.018 (-0.54)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Adj. R ²	0.690	0.683	0.612	0.611
Observations	28,912	25,737	28,912	25,737

Table 13
IM Patents and Future Stock Return

This table presents Fama-MacBeth regressions of monthly stock return on IM patents based on innovation intensity. We separate firms into high and low innovation intensity based on the total number of patents filed by the firm up to the current year. A firm is classified as innovation intensity firm if its total patent filings up to the current year is above the yearly sample median. Panel A presents the results of high innovation intensity firms. The dependent variable is the monthly stock return from July year t to June year $t+1$ and the independent variable is *Proportion IM* of year $t-1$. *Proportion IM* is defined as the cumulative number of IM patents up to the current year scaled by the cumulative number of total patents filed by the firm up to the current year. $\ln(\text{Patent Stock})$ is the natural logarithm of the cumulative patents filed up to the current month. *BM* is the book-to-market ratio. $\ln(\text{ME})$ is natural logarithm of market capitalization in June. *Ret [-1]* is the previous monthly return. *Ret [-12, -2]* is the buy-and-hold return from month $t-12$ to month $t-2$. *Assets growth* is annual change in total assets, scaled by lagged total assets. *ROE* is return to equity. Panel B is similar to Panel A, except it presents the results of low innovation intensity firms. Some models include one-digit SIC industry fixed effects. All t-statistics are based on Newey-West standard errors with nine lags.

Panel A: High Innovation Intensity Firms

Dep. Var.	Stock Return		
	(1)	(2)	(3)
Proportion IM	-0.0083** (-2.06)	-0.0090** (-2.34)	-0.0098** (-2.50)
$\ln(\text{Patent Stock})$		0.0007*** (3.60)	0.0006*** (2.94)
BM		0.0033** (2.45)	0.0036*** (2.68)
$\ln(\text{ME})$		-0.0006 (-1.48)	-0.0005 (-1.23)
<i>Ret</i> [-1]		-0.0332*** (-7.14)	-0.0344*** (-7.40)
<i>Ret</i> [-12,-2]		0.0028 (1.22)	0.0026 (1.11)
Asset Growth		-0.0015 (-1.54)	-0.0014 (-1.44)
ROE		0.0018* (1.75)	0.0016* (1.66)
Industry FE	No	No	Yes
Adj. R^2	0.002	0.063	0.084
Ave. #Firms	758	758	758

Panel B: Low Innovation Intensity Firms

Dep. Var.	Stock Return		
	(1)	(2)	(3)
Proportion IM	0.0007 (0.55)	0.0017 (1.27)	0.0017 (1.30)
ln(Patent Stock)		0.0002 (0.44)	0.0003 (0.69)
BM		0.0026** (2.14)	0.0026** (2.15)
ln(ME)		0.0002 (0.67)	0.0003 (0.82)
Ret[-1]		-0.0330*** (-7.32)	-0.0350*** (-7.64)
Ret[-12,-2]		0.0024 (0.93)	0.0022 (0.82)
Asset Growth		-0.0020*** (-3.06)	-0.0020*** (-3.18)
ROE		0.0010 (1.57)	0.0009 (1.37)
Industry FE	No	No	Yes
Adj. R ²	0.002	0.057	0.082
Ave. #Firms	675	675	675

Appendix A

Variable Definition

Variable	Definition
Patent Level Variables:	
FYE Patent	Dummy variable that equals one if a patent is filed in the last month of the fiscal year, and zero otherwise.
IM Patent	Dummy variable that equals one if its average inventor FYE tendency is above the median of the FYE patents in the previous year, and zero otherwise. Inventor FYE tendency is defined as the proportion of the inventor's FYE patent filings among all her patent filings in the year. Average inventor FYE tendency is calculated as the average inventor FYE tendency for the patent.
Non-IM Patent	Dummy variable that equals one if the patent is filed in the fiscal year end month, and its FYE tendency is less than or equal to the sample median of the FYE patents in the previous year, and zero otherwise.
Citation	Number of forward citations received by the patent.
Adjusted Citation	Truncation-adjusted future citations. The truncation is adjusted by dividing patent citations by the mean number of citations filed in that year and within the same three-digit technology class.
Originality	Number of unique technology subclasses cited by the focal patent.
No Citation	Dummy variable that equals one if the patent receives no future citation.
Breakthrough Patent	Dummy variable that equals one if the forward citation count is in the top 5% of all patents in the same application year and technology class.
#Claims	Total number of claims contained in the patent.
#Independent Claims	Total number of independent claims contained in the patent.
#Dependent Claims	Total number of dependent claims contained in the patent.
ln(Number of Words)	The natural logarithm of total number of words in the description section.
Gunning Fog	The Gunning Fog index of the description section of a patent.
Automated Reading	The Automated Readability index of the description section of a patent.
Flesch Reading	The Flesch Reading index of the description section of a patent.
#Figures	The total number of figures in the patent text.
#Sheets	The total number of sheets in the patent text.
Firm-month level Variables:	
#Patents	The total number of patents filed in the fiscal month.
ln(Patent Stock)	Natural logarithm of patents filed up to the current year.
Stock Return	Monthly stock return.
Ret[-1]	Monthly stock return in month t-1.
Ret[-12,-2]	Buy-and-hold return from month t-12 to month t-2.
ROE	Income before extraordinary items scaled by total equity.
Asset Growth	Annual change in total assets, scaled by lagged total assets.
BM	Book to market ratio.
Firm-Year level Variables:	
Proportion IM	The cumulative number of IM up to the current year scaled by cumulative number of total patents filed by the firm up to the current year.
OCF	Operating cash flow scaled by the total assets.
ROA	Net income scaled by total assets.
Size	The logarithm of total assets.
Firm Age	Number of years since the year of the company's IPO.
Cash	Cash scaled by total assets.
Leverage	Total debt scaled by total equity.

Variable	Definition
CAPX	Capital expenditures scaled by total assets.
PPE	Net property, plant, and equipment scaled by total assets.
CEO Horizon	$CEO\ Horizon_{i,t} = [Tenure_{ind,t} - Tenure_{i,t}] + [Age_{ind,t} - Age_{i,t}]$, where $Tenure_{ind,t}$ is the industry average tenure of all CEOs in year t, $Tenure_{i,t}$ is the tenure of CEO i in year t, $Age_{ind,t}$ is the industry average age of all CEOs in year t, and $Age_{i,t}$ is the age of CEO i in year t.
CEO Unexercised Options %IM	Unexercised stock options scaled by total compensation. Number of IM patents filed by a firm in a year divided by the firm's total patent filings that year.
#Patent_1_3M _{t+1}	Total number of a firm's patent filings in the following year during months 1–3.
#Patent_4_6M _{t+1}	Total number of a firm's patent filings in the following year during months 4–6.
#Patent_7_9M _{t+1}	Total number of a firm's patent filings in the following year during months 7–9.
Inventor-Patent level Variables:	
Trailing_3Qtrs	Dummy variable equal to one if the total number of patents filed by an inventor in the first three quarters of the year is lower than the first three quarters of the previous year, and zero otherwise.
Trailing_11M	Dummy variable equal to one if the total number of patents filed by an inventor in the first eleven months of the year is lower than the first eleven months of the previous year, and zero otherwise.
Working Years	The number of years an inventor has worked.
Total Patents Filed	The total number of patents filed by the inventor up to the current year.
Average Adjusted Citation	The average truncation adjusted citation for patents filed by the inventor up to the current year.
Average Originality	The average originality of patents filed by the inventor up to the current year.
Total Breakthrough Patents	The total number of breakthrough patents filed by the inventor up to the current year.
Inventor Level Variables:	
%Inventor IM Patent	Number of IM patents filed, scaled by the total number of patents filed by an inventor in a year.
Turnover _{t+1}	Dummy variable that equals one if an inventor moves to another company in the next year.

Appendix B: Additional Results

Table B1
Alternative Measure of IM Patents

This table examines the quality of IM patents using an alternative innovation management measure. Panel A presents the results of citations. The dependent variable is *Raw Citation* in Columns (1) and (2), and *Adjusted Citation* in Columns (3) and (4). The independent variable is *IM Industry Patent*. *IM Industry Patent* is a dummy variable that equals one if the FYE tendency is above the sample median of firms in the same 2-digit SIC industry from the previous year, and zero otherwise. Panel B is similar to Panel A except we use other patent quality measures. The dependent variable is *Originality* in Column (1), *No Citation* in Column (2), and *Breakthrough Patent* in Column (3). We control for filing year, art unit, and firm fixed effects. T-statistics using robust standard errors adjusted for heteroscedasticity and clustered at the firm level are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Adjusted Citation

Dep. Var.	Raw Citation	Adjusted Citation
	(1)	(2)
IM Industry Patent	-0.942*** (-7.47)	-0.070*** (-10.39)
Filing Year FE	Yes	Yes
Firm FE	Yes	Yes
Art Unit FE	Yes	Yes
Adj. R ²	0.288	0.079
Observations	2,255,283	2,255,283

Panel B: Other Patent Quality Measures

Dep. Var.	Originality	No Citation	Breakthrough Patent
	(1)	(2)	(3)
IM Industry Patent	-0.144*** (-5.64)	0.021*** (10.90)	-0.005*** (-7.05)
Filing Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Art Unit FE	Yes	Yes	Yes
Adj. R ²	0.225	0.320	0.044
Observations	2,067,214	2,067,214	2,067,214

Table B2**Inventor Pressure and Innovation Management: Robustness Tests Using Lead Inventors**

This table is similar to Table 8, except that we only include the lead inventor for each patent in the analyses. In Panel A, the dependent variable is *IM Patent*, which is a dummy variable for patent associated with innovation management. The independent variable is *Trailing_3Qtrs* in Column (1) and *Trailing_11M* in Column (2). *Trailing_3Qtrs* is a dummy variable that equals one if the total patents filed by an inventor in the first three quarters of this year are less than the total number of patents filed in the first three quarters of the previous year, and zero otherwise. *Trailing_11M* is similarly defined as *Trailing_3Qtrs*, except it equals one if the total patents filed in the first eleven months of this year are less than those filed in the previous year. Panel B presents the results of inventor's working experience. The dependent variable is *IM Patent*. The independent variable is *Working Years_{t-1}* in Columns (1), and *Total Patents Filed_{t-1}* in Columns (2). *Working Years_{t-1}* is the number of years an inventor has worked up to the previous year. *Total Patents Filed_{t-1}* is the total number of patents filed by the inventor up to the previous year. Panel C presents the results of inventor's past performance. The independent variable is the *Average Adjusted Citation_{t-1}* in Column (1), and *Average Originality_{t-1}* in Column (2), and *Total Breakthrough Patent_{t-1}* in Column (3). *Average Adjusted Citation_{t-1}* is the average truncation adjusted citation for patents filed by the inventor up to the previous year. *Average Originality* is the average originality of patents filed by the inventor up to the previous year. *Total Breakthrough Patents* is the total number of breakthrough patents filed by the inventor up to the previous year. We control for filing year, art unit, and firm fixed effects. T-statistics using robust standard errors adjusted for heteroscedasticity and clustered at the firm level are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Trailing in Early Months

Dep. Var.	IM Patent	
	(1)	(2)
Trailing_3Qtrs	0.064*** (23.36)	
Trailing_11M		0.160*** (28.08)
Filing Year FE	Yes	Yes
Firm FE	Yes	Yes
Art Unit FE	Yes	Yes
Adj. R ²	0.059	0.096
Observations	1,709,625	1,709,625

Panel B: Working Experience

Dep. Var.	IM Patent	
	(1)	(2)
Working Years _{t-1}	-0.0002*** (-4.11)	
Total Patents Filed _{t-1}		-0.0003*** (-10.06)
Filing Year FE	Yes	Yes
Firm FE	Yes	Yes
Art Unit FE	Yes	Yes
Adj. R ²	0.018	0.022
Observations	1,672,276	1,672,276

Panel C: Past Performance

Dep. Var.	IM Patent		
	(1)	(2)	(3)
Average Adjusted Citation _{t-1}	-0.0026*** (-8.70)		
Average Originality _{t-1}		-0.0003*** (-7.36)	
Total Breakthrough Patent _{t-1}			-0.0023*** (-12.11)
Filing Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Art Unit FE	Yes	Yes	Yes
Adj. R ²	0.018	0.018	0.020
Observations	1,672,276	1,672,276	1,672,276