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LGBTQ-friendly employee policies and corporate innovation☆,☆☆

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ABSTRACT

This paper examines the association between LGBTQ-friendly employee policies and corporate innovation. Using data on large U.S. firms, we document that LGBTQ friendliness has a positive influence on innovation intensity and quality. Specifically, our results demonstrate that LGBTQ-friendly firms produce more patents, have more patent citations, and are associated with higher innovation quality as measured by patent originality, generality, and internationality. Furthermore, our empirical findings indicate that LGBTQ friendliness is positively associated with the firm-level concentration of innovative talent. Overall, our results are consistent with the view that diversity management policies may lead to competitive advantages for the firm.

1. Introduction

> "*I've had the good fortune to work at a company that loves creativity and innovation and knows it can only flourish when you embrace people's differences*."
>
> Tim Cook, CEO of Apple Inc.

This paper focuses on the effects of LGBTQ-friendly employee policies on corporate innovation. Abundant evidence documented in the management literature suggests that employee policies related to the advocacy and support of sexual minorities may advance a wide range of desired corporate outcomes. Specifically, previous studies have found that firms with more inclusive policies that better embrace lesbian, gay, bisexual, transgender, and queer (LGBTQ) employees are associated with greater employee commitment, improved job satisfaction, and higher employee productivity (see e.g., Button, 2001; Day & Shoenrade, 1997, 2000; Ragins et al., 2007; Ragins & Cornwel, 2001; Shan et al., 2017). Furthermore, LGBTQ-friendly policies may influence firm

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reputation among the key stakeholders and promote competitiveness in the labor market by improving the firm's ability to attract and recruit talented employees (e.g., Day & Greene, 2008; Huffman et al., 2008; Metcalf & Rolfe, 2011; Trau, 2015; Wettstein & Baur, 2016).[1] In addition to accumulating intangibles related to human capital and stakeholder relations, LGBTQ friendliness has been found to improve financial performance and increase the firm's market valuation (Fatmy et al., 2022; Jiraporn et al., 2019; Li & Nagar, 2013; Pichler et al., 2018; Shan et al., 2017).[2] In this paper, we aim to contribute to the existing literature by examining whether progressive LGBTQ policies foster corporate innovation.

The underlying logic linking LGBTQ-friendly corporate policies to innovation builds on the human resource management (HRM) theories regarding employee satisfaction and diversity management. These theories recognize employees as the firm's key asset and a focal source of competitive advantage and value creation (e.g., Beneish et al., 2022; Cascio, 1991; Coff, 1997; Edmans, 2012; Faleye & Trahan, 2011; Gelade & Ivery, 2003; Huselid, 1995; Whitener, 2001). Accordingly, a vast body of research has documented that intangible investments in employee-friendly practices and organizational diversity management policies benefit firms, for instance, by advancing employee motivation and engagement, labor stability and productivity, and the firm's ability to recruit and retain the best talent (e.g., Armstrong et al., 2010; Edmans, 2011, 2012; Fauver et al., 2018; Jackson et al., 2003; Kochan et al., 2003; Richard, 2000; Waddock & Graves, 1997; Wright et al., 1995). Loosely parallel with the HRM arguments, the stakeholder theory established by Freeman (1984) posits that engagement in social activities and investments in employee welfare and satisfaction may pay off by enhancing the firm's relational and reputational capital with its employees and other stakeholders. Given that inclusive and non-discriminatory employee policies in general, and the embracement of sexual minorities in particular, may lead to positive outcomes and competitive advantages for the firm, we expect to find a positive relationship between LGBTQ-friendly employee policies and corporate innovation.

Alternatively, it may be argued that LGBTQ friendliness does not influence or may even have a negative effect on corporate innovation. Legitimacy theory (Dowling & Pfeffer, 1975) posits that organizations align their practices with the prevailing norms, values, and expectations of the societies in which they operate in order to gain social approval and access to potential resources. Consistent with the arguments presented by Schopohl et al. (2024), this suggests that firms operating in environments that expect LGBTQ-friendly practices may adopt these practices without being incentivized by the strategic benefits of employee productivity, creativity, and innovation. Furthermore, based on the agency theory (Jensen & Meckling, 1976), it can be argued that self-interested managers may pursue symbolic or superficial diversity initiatives to enhance their reputation, potentially sacrificing financial and talent-specific resources for personal reputation. These short-sighted investments in inclusive practices may reflect the proclivity of managers acting in their own self-interest to avoid sophisticated planning and resource allocation (Bertrand & Mullainathan, 2003; Chen et al., 2016), and to misuse excess free cash flows (Jensen, 1986). Based on these theories, an alternative hypothesis is that LGBTQ-friendly employee policies have no effect on corporate innovation.

Our paper contributes to the growing body of literature on factors influencing innovation activity and the determinants of innovative corporate environments. Hsu et al. (2014), Ucar (2018), Gupta et al. (2020), Hasan et al. (2020), Boubakri et al. (2021), Dai et al. (2021), Elmawazini et al. (2022), among others, have documented that investments in innovation and innovation outcomes are affected by a variety of attributes related to firms' operating environment and geographical location such as institutional arrangements and legal environment, financial market development, local culture, media scrutiny, and the level of social capital. Over the past few years, several studies have examined how specific firm characteristics are reflected in innovation efforts and productivity. These studies suggest that success in innovation is related to managerial characteristics and incentives, ownership structure, board composition, and corporate governance mechanisms (see e.g., Manso, 2011; Hirshleifer et al., 2012; Aghion et al., 2013; Atanassov, 2013; Ederer & Manso, 2013; Tian & Wang, 2014; Lu & Wang, 2018; Biggerstaff et al., 2019; Chang et al., 2019; Chemmanur et al., 2019; Custódio et al., 2019; Islam & Zein, 2020; Lan et al., 2024).

Two distinct streams of innovation literature are closely related to our study. First, studies by Østergaard et al. (2011), Chen, Chen, et al. (2016), Chen, Leung, and Evans (2016), Schubert and Tavassoli (2020), An et al. (2021), Cumming and Leung (2021), Griffin et al. (2021), and Asad et al. (2023) examine the relations between corporate innovation, employee diversity, and diversity in the composition of the management teams and board of directors. In brief, the previous studies suggest that diversity in human capital resources in terms of age, gender, ethnicity, and education is positively associated with investments in innovation and patent-based measures of innovation success. These findings provide support for the view that diversity management policies and diversity-embracing corporate culture may benefit the firm by fostering innovation activity.

The second related strand of innovation literature focuses on employee-friendly policies and employment non-discrimination acts. Chen, Chen, et al. (2016) and Chen, Leung, and Evans (2016) document that employee-friendly firms invest more in research and development and have greater innovation output as measured by the number of patents and patent citations. In the same vein, the results of Mao and Weathers (2019) suggest that employee friendliness has a positive influence on patent-based measures of innovation intensity and quality.[3] Perhaps most directly related to our paper, Gao and Zhang (2016) investigate the effects of employment nondiscrimination acts on corporate innovation by exploiting the enactment in anti-discrimination legislation across the different U.S. states. Their findings indicate that the adoption of laws that prohibit employment discrimination based on sexual orientation leads to an increase in the number of patents and patent citations for firms headquartered in the adopting states. Collectively, the empirical findings of Chen, Chen, et al. (2016), Chen, Leung, and Evans (2016), Gao and Zhang (2016), and Mao and Weathers (2019) demonstrate that employee-supportive policies and inclusive, non-discriminatory operating environments are conducive to innovation. In this paper, we extend the existing literature by examining the effects of firm-level LGBTQ friendliness on innovation intensity and quality.

We test the hypothesis that LGBTQ-friendly employee policies foster corporate innovation using data on large publicly traded U.S. firms over the period 2003–2017.[4] Following the prior literature (e.g., Everly & Schwarz, 2015; Fatmy et al., 2022; Roumpi et al., 2020; Schopohl et al., 2024; Shan et al., 2017), we employ the Corporate Equality Index (CEI)

[1] Anecdotal support for this view can be found in the *amici curiae* brief submitted to the U.S. Supreme Court in July 2019 by the representatives of 206 prominent firms such as Amazon, Apple, Coca-Cola, Facebook, General Motors, Goldman Sachs, Google, JPMorgan Chase, Microsoft, and Walt Disney. The brief asserts that a law prohibiting discrimination based on sexual orientation in the workplace "would strengthen and expand benefits to businesses, such as the ability to recruit and retain top talent".

[2] See Brahma et al. (2023) for a comprehensive literature review on the role of LGBTQ-friendly policies on financial outcomes.

[3] Chen, Chen, et al. (2016), Chen, Leung, and Evans (2016), and Mao and Weathers (2019) identify employee-friendly firms based on their inclusion in the Fortune's list of the "100 Best Companies to Work for in America" and KLD's corporate social responsibility metrics related to firms' employee relations.

[4] In some of our additional tests, we utilize data on the number of patents and patent citations for the years 2003–2024.

constructed by the Human Rights Campaign to measure firm-level LGBTQ friendliness. The CEI is considered to provide a comprehensive assessment of a firm's LGBTQ friendliness in terms of corporate policies and practices that pertain to LGBTQ employees and public advocacy related to the rights of sexual minorities. To gauge corporate innovation intensity and quality, we use data on patents granted by the U.S. Patent and Trademark Office. Specifically, we measure the intensity of the firm's innovation output by the number of patents granted and utilize patent citations as well as the originality, generality, and internationality of the patents granted as proxies for innovation quality. In addition, we use the inventor count extracted from unique patent assignee names as an additional measure of innovation intensity and firm-level concentration of innovative talent. We empirically examine the effects of progressive LGBTQ policies on the different patent-based measures of innovation intensity and quality by estimating three-way fixed-effects panel regressions in which we control for a wide variety of firm characteristics including research and development investments, capital expenditures, and the overall engagement in employee-friendliness as well as time-invariant unobservable differences across different industries and states.

Consistent with our research hypothesis, we find strong evidence that LGBTQ-friendly firms are more innovative. Our empirical findings demonstrate that firms with more LGBTQ-friendly employee policies produce significantly more patents, have more patent citations and higher patent quality as well as a higher concentration of individual inventors as employees. Regardless of the patent-based innovation measure used, the positive effect of LGBTQ friendliness on innovation output is found to be economically meaningful in addition to being statistically significant. Our estimates suggest that a one standard deviation increase in the firm's CEI is associated with an over 20 % increase in the patent count and an almost 25 % increase in the number of patent citations. Overall, these results suggest that progressive LGBTQ policies enhance corporate innovation.

We utilize two-stage instrumental variable (IV) regressions, propensity score matching, and difference-in-differences (DiD) analysis centered on the 2015 U.S. Supreme Court ruling that legalized same-sex marriage across all states to alleviate potential endogeneity concerns and facilitate causal inferences. These tests give further support for the hypothesis that LGBTQ-supportive policies have a positive influence on corporate innovation. Specifically, both the instrumental variable regressions and the propensity score matching analysis demonstrate that LGBTQ-friendly firms are more innovative and produce more patents and have higher patent quality. Our DiD analysis suggest that the 2015 Supreme Court ruling significantly increased corporate innovation in states that previously did not recognize same-sex marriage, but only among firms that had above-average CEI scores prior to the ruling.

We also conduct a number of additional tests that suggest that our empirical findings are robust to alternative model specifications and econometric estimation techniques, potential self-selection biases, different control variables and variable definitions as well as many different sample restrictions. Among other things, the results of our robustness checks indicate that the positive association between LGBTQ friendliness and innovation cannot be explained by state-level differences in innovation activity, social conservatism, or anti-discrimination legislation. Furthermore, the additional tests suggest that LGBTQ-friendly corporate policies have an incremental impact on innovation performance over and above the influence of more generic diversity considerations and the firm's overall engagement in social responsibility. Taken as a whole, the empirical findings reported in this paper provide additional evidence for the view that socially progressive corporate policies pay off.

The remainder of the paper proceeds as follows. Section 2 describes the data and introduces the variables used in the analysis. In Section 3, we empirically examine the relation between LGBTQ-friendly employee policies and corporate innovation. Finally, Section 4 summarizes the findings and concludes the paper.

2. Data and variables

2.1. Data

The sample used in our empirical analysis consists of large publicly traded U.S. firms over the period 2003–2017.[5] The data are collected from three different sources. First, we use the Corporate Equality Index (CEI) scores obtained from the Human Rights Campaign (HRC) to measure firm-level LGBTQ friendliness. Second, we use data on patents granted by the U.S. Patent and Trademark Office (USPTO) jointly with global patent citation data obtained from the Google Patents database to construct alternative patent-based measures of corporate innovation intensity and quality. Third, we collect financial statement and balance sheet data for the sample firms from Compustat.

Out of 968 firms assessed by the HRC in the period 2003–2017, 905 firms can be linked to Compustat data. Out of these 905 firms, 805 firms are headquartered in the U.S. and have at least one observation with positive book assets and market capitalization during our sample period. After excluding financial entities (SIC codes 6000 to 6799), we are left with a sample of 614 firms and an unbalanced panel of 4902 firm-year observations.

Table A1 in Appendix 1 presents the distribution of our sample and the average number of patents by year, industry, and state. The sample is relatively evenly distributed across the sample period, although the average number of patents appears to decline over time, reflecting a reduction in innovation intensity. In contrast, the distribution across industries shows greater variation, with firms in the Utilities, Manufacturing, and Agriculture sectors exhibiting the highest patent counts. Corporate innovation also varies considerably across states, with firms headquartered in Idaho, Delaware, Washington, Massachusetts, and California having the highest patent counts.

2.2. LGBTQ friendliness

We employ the Corporate Equality Index (CEI) constructed by the Human Rights Campaign to measure firm-level LGBTQ friendliness. The Human Rights Campaign is the largest sexual minorities advocacy organization in the U.S. and it has published the CEI for large U.S. firms annually since 2002. The CEI provides a comprehensive assessment of a firm's LGBTQ friendliness in terms of corporate policies and practices that pertain to LGBTQ employees and public advocacy related to the rights of sexual minorities, and it has been commonly used to gauge LGTBQ friendliness in the prior literature (see e.g., Everly & Schwarz, 2015; Fatmy et al., 2022; Roumpi et al., 2020; Schopohl et al., 2024; Shan et al., 2017; Wang & Schwarz, 2010).

The Human Rights Campaign compiles and constructs the CEI through SEC filings, employee resource groups, press releases, news articles, and company surveys during the year leading up to the date of publication. The surveys underlying the CEI are sent to the S&P 500 firms, the Fortune 1000 firms, the firms in the Forbes' list of 200 largest privately-held companies, and other U.S. firms with at least 500 employees. In our empirical analysis, the sample is constrained to publicly traded firms.

The CEI is based on five main criteria related to firms' employee policies, workplace equality, diversity culture and competency, and public statements and actions related to either advocacy or discrimination of sexual minorities. The criteria underlying the CEI are summarized in Table 1. Each of the considered criteria is given a specific amount of points and the CEI is then constructed for each firm as the sum of the points of the individual evaluation criteria. Consequently, the CEI may take values between −25 and 100 with higher values of the index corresponding to more LGBTQ-friendly corporate policies and practices.

[5] In additional tests, we extend the sample period and collect data on the number of patents and patent citations for the years 2003–2024.

Table 1
The criteria underlying the Corporate Equality Index (CEI).

Criteria 1	Equal Employment Opportunity policies	
	a) Sexual Orientation for all operations	15 points
	b) Gender Identity for all operations	15 points
	c) Contractor/Vendor standards include sexual orientation and gender identity	5 points
Criteria 2	Employment benefits	
	a) Equivalent Spousal and Partner benefits	10 points
	b) Other "soft" benefits	10 points
	c) Transgender inclusive health insurance coverage	10 points
Criteria 3	Organizational LGBT competency	
	a) Competency training, resources and accountability measures	10 points
	b) Employee group or Diversity council	10 points
Criteria 4	Public commitment	
	LGBT-specific efforts (recruitment, philanthropy etc.)	15 points
Criteria 5	Deductions for large-scale anti-LGBT blemish	
	25-point reduction for recent cases of LGBT discrimination	100 points

2.3. Corporate innovation

The response variable in our empirical analysis is corporate innovation. Following the prior literature (see e.g., Balsmeier et al., 2017; Beneish et al., 2022; Chen et al., 2018; Gupta et al., 2020; Hasan et al., 2020; Ho et al., 2024; Mao & Weathers, 2019), we measure corporate innovation intensity and quality through patents granted by the USPTO. Specifically, we employ six alternative measures of innovation: (i) the number of patents, (ii) the number of patent citations, (iii) patent originality, (iv) patent generality, (v) patent internationality, and (vi) the number of individual employees as patent assignees. These innovation measures are based on patent data from the USPTO and global patent citation data obtained from Google Patents in January 2020. We utilize patent identification numbers (patent_id), and use the US Patents linking table available through the Wharton Research Data Services (WRDS) to match the USPTO patent assignees to Compustat Global Company Keys (GVKEY).[6] Out of 3,695,956 granted patents filed during the period 2003–2017, we are able to link 1,835,449 patents to individual firms with a GVKEY. When constructing the alternative patent-based measures of innovation intensity and quality, we follow the prior literature (e.g., Bena et al., 2017; Gao & Zhang, 2016; Ucar, 2018) and assume that firms produce zero patents if their patent information is missing.[7]

We measure the intensity of the firm's innovation output by the annual number of patents granted and the annual number of patents adjusted by the average number of patents granted in each NBER technological class and year. *Patents* is defined as the patent count for a given firm and filing year and $Patents_{Adj}$ is calculated following the two-way fixed-effects adjustment of Hall et al. (2001) which purges the patent count of any effects due to systematic changes in innovation intensity over time or across technological classes. In the construction of the patent-based innovation variables, we use the patent's filing year instead of its grant year because the former arguably better captures the actual time of innovation (see e.g., Griliches et al., 1991). Given that innovation activity is concentrated in a relatively small set of firms and most firms have zero patents, we use the inverse hyperbolic sine transformation to normalize our highly-skewed dependent variables which are based on zero-bounded count data.[8]

Patent citations reflect the quality of the firm's innovation output. As noted e.g. by Albert et al. (1991), Trajtenberg et al. (1997), and Hall et al. (2001), the number of citations a patent receives indicates the practical and economic importance of the innovation and also reflects the differences in innovation activities across firms. *Citations* is measured as the annual total global citation count for the firm's patents registered on the filing year of each citing patent. Given that patent citations are subject to backward and forward lags as well as a truncation bias, we follow Hall et al. (2001) to calculate year and technological class adjusted patent citations. $Citations_{Adj}$ is measured as the total number of patent citations per patent adjusted by the average citation count of patents in each technological class during the patent filing year.

In addition to patent citation counts, we use patent originality, generality, and internationality as additional proxies for innovation quality. Proposed by Trajtenberg et al. (1997) and Hall et al. (2001), patent originality and generality represent the proximity of the cited patents to the original scientific sources and the versatility of the cited patent across different technological classes. *Originality* is measured as the number of NBER technological classes spanned by the cited patents, with a more original patent building upon more diverse sources. *Generality* is measured as the number of NBER technological classes spanned by the citing patents, with higher generality indicating greater applicability of the patent across different fields. We employ patent internationality as a novel proxy for innovation quality. *Internationality* is measured as the number of patent assignee countries spanned by the citing patents. Higher internationality indicates that the patent is internationally more valuable with the innovation being utilized outside the U.S. We also scale patent originality, generality, and internationality by the corresponding aggregate annual measures for the technological class of the granted patent to adjust for any systematic biases and trends. The resulting adjusted variables used in the regressions are $Originality_{Adj}$, $Generality_{Adj}$, and $Internationality_{Adj}$, respectively.

Finally, following Jaffe et al. (1993), we use inventor count as an additional measure of innovation intensity and the concentration of innovative talent on a firm-level. The number of individual inventors for each firm and year is calculated on the basis of unique inventor names extracted from all the firm's patents granted in a given year. However, the raw inventor count fluctuates over time to a greater extent than would be expected based on general employee retainment and mobility. Therefore, similar to the perpetual inventory method used in economics and finance literature to account for the accumulation of intangible capital over time, we construct a memory-adjusted inventor count by acknowledging the firm's non-filing prior inventors at an annual rate of

[6] As an auxiliary mapping between patent assignees and publicly listed firms, we utilize the Global Corporate Patent Dataset (GCPD) compiled by the University of Virginia Darden School of Business. The GCPD is constructed based on the matching algorithm described in Bena et al. (2017).

[7] In the regressions, we include a dummy variable for zero-imputed patents counts.

[8] The conventional approach of using the logarithm of one plus the number of patents is a problematic transformation in innovation research and may lead to biased estimates with highly-skewed zero-bounded count data (see e.g., Campbell & Mau, 2021; Cohn et al., 2021). Nevertheless, as a robustness check, we have also used the conventional logarithmic transformation to our dependent variables. The estimates of these additional regressions are consistent with our main analysis.

0.8^n, where n is the number of years from the non-filing inventor's previous patent.[9] If an inventor moves to a different firm, she is removed from the firm's memory-adjusted inventor count irrespective of n. We adjust the inventor counts for each firm by the annual average number of inventors per a patent-filing firm. *Inventor count* is defined as the number of individual inventors listed in the patents filed by a firm in a given year scaled by the total amount of individual inventors in a given year and multiplied by the average annual total number of inventors. Correspondingly, *Inventor count*$_{Adj}$ is the firm's memory-adjusted inventor count scaled by the total annual amount of individual inventors and multiplied by the average annual total number of inventors.

2.4. Control variables

Following the prior corporate innovation literature (e.g., Boubakri et al., 2021; Chen et al., 2018; Gupta et al., 2020; Islam & Zein, 2020; Mao & Weathers, 2019), we include a number of controls variables in our regressions to account for the confounding effects of firm-specific factors such as size, financial performance, research and development expenditures, and employee treatment on innovation intensity and quality. The financial data used for constructing the control variables are taken from Compustat.

The control variables are defined as follows: (i) *Size* is measured as the logarithm of total assets, (ii) *Profitability* is measured with return on assets (ROA) which is calculated as the ratio of net income to total assets, (iii) *Cash* is the logarithm of one plus cash holdings scaled by total assets, (iv) *Leverage* is the ratio of total liabilities to total assets, (v) *Total Q* is the intangible capital adjusted Tobin's Q proposed by Peters and Taylor (2017) calculated as the logarithm of one plus the sum of the firm's market value of equity and the book value of liabilities minus current assets divided by the sum of the gross value of property, plant, and equipment and the estimated replacement cost of the firm's intangible capital, (vi) *R&D* is the logarithm of one plus research and development expenditures scaled by total assets,[10] (vii) *Capex* is the logarithm of capital expenditures scaled by total assets, and (viii) *Employee-friendly* is a dummy variable that equals one for firms which are included in the Fortune's list of the 100 Best Companies to Work For in America in a given year.

2.5. Descriptive statistics and correlations

Descriptive statistics for LGBTQ friendliness (*CEI score*), the six different measures of corporate innovation intensity and quality, and the control variables are reported in Table 2. For ease of interpretation, we present all variables in their original forms without any transformations. The mean (median) *CEI score* for the sample firms is 65.84 (80.00) with a standard deviation of 34.38. As can be seen from the table, the level of LGBTQ friendliness spans the full index spectrum from −25 to 100.

Innovation intensity and quality vary substantially across firms. The mean annual patent count for the sample firms is 88.38 and the mean citation count 778.69. The sample firms, on average, have 118.32 individual employees who have filed successful patents. As can be seen from Table 2, the medians for all innovation measures are very low and the minimum values are zeros, indicating that innovation activity is concentrated in a relatively small set of firms. With respect to the control variables, the descriptive statistics indicate that our sample exhibits considerable dispersion also in terms of the control variables. The mean of total assets (*Size*) of the sample firms is about $26.6 billion and the mean ROA (*Profitability*) is about 5 %. *Total Q* varies from −0.93 to 12.87 with a mean of 1.12, and *Cash* and *Leverage* fluctuate substantially around their means. Finally, it can be noted that about 6 % of the firm-year observations are included in the Fortune's best employers list.

Table 3 presents the pairwise correlations between the variables used in the regressions. As can be seen from the table, *CEI score* is positively correlated with all six innovation measures. Thus, consistent with the hypothesis that LGBTQ-supportive employee policies foster corporate innovation, the correlation coefficients suggest that LGBTQ-friendly firms produce more patents, have higher patent quality, and have a higher number of individual employees who have filed successful patents. Table 3 further shows that *CEI score* is positively correlated with *Size*, *Profitability*, *Cash*, *Total Q*, *R&D*, and *Employee-friendly*, while being negatively correlated with *Capex*. The strong positive correlation between *CEI score* and *Size* ($r = 0.19$, $p < 0.01$) is broadly consistent with the view that large, well-established firms are generally able to provide better employee benefits. Moreover, given that LGBTQ-friendly firms are likely to have an employee-supportive working environment and good employee relations, it is not surprising that *CEI score* correlates positively with *Employee-friendly* ($r = 0.15$, $p < 0.01$).

The six different corporate innovation measures are strongly positively correlated with each other. The highest correlation coefficients are those between *Patents* and *Originality* ($r = 0.98$), *Citations* and *Internationality* ($r = 0.98$), and *Originality* and *Internationality* ($r = 0.97$). The innovation measures are also statistically significantly correlated with all of our control variables. The correlations indicate that innovative firms are larger, perform better, have higher cash holdings, invest more in R&D activities, and are more likely to have employee-friendly working environments. Regarding the correlations among the control variables, Table 3 shows that *Total Q* exhibits a strong positive correlation with *Profitability*, *R&D*, and *Employee-friendly*, and a negative correlation with *Leverage*.

3. Empirical analysis

3.1. Univariate analysis

We begin our empirical analysis by performing *t*-tests to examine differences between more LGBTQ-friendly and less LGBTQ-friendly firms. For this purpose, we split the firms into two subsamples based on their CEI scores; the subsample of more LGBTQ-friendly firms comprises the firms that have a CEI score of 100 (approximately corresponding CEI scores in the top quartile), while the subsample of less LGBTQ-friendly firms consists of firms with CEI scores of less than 45 (corresponding to CEI scores in the bottom quartile).

Table 4 presents the results of two-tailed *t*-tests. Overall, the univariate tests demonstrate that LGBTQ friendliness is strongly associated with firm characteristics as almost all the mean differences between the two subsamples are statistically highly significant. As can be noted from Table 4, the differences in all different innovation measures between the more LGBTQ-friendly and less LGBTQ-friendly firms are positive and significant at the 1 % level, and thereby suggest that firms with more LGBTQ-friendly policies have greater innovation intensity and produce more valuable innovations. Therefore, the *t*-tests provide support for the hypothesis that LGBTQ-supportive employee policies spur corporate innovation.

The observed differences in the innovation measures can also be considered economically meaningful; the mean difference in the number of patents is 149.95 and the mean difference in the number of patent citations is 1362.41, with both of these differences corresponding to almost a half standard deviation of the corresponding variables. Moreover, the mean inventor count is about 214 individuals, or about two-thirds of a standard deviation, higher in the more LGBTQ-friendly

[9] Consider a firm with two individual inventors, Minnie and Mickey. Suppose that Minnie is a patent assignee in 2010, 2011, and 2013 and Mickey is a patent assignee only in 2011. The raw inventor count for the firm would be 1 in 2010, 2 in 2011, 0 in 2012, and 1 in 2013. The memory-adjusted inventor count would be 1 in 2010, 2 in 2011, $0.8^1 + 0.8^1 = 1.6$ in 2012, and $1 + 0.8^2 = 1.64$ in 2013.

[10] Because of the large number of missing values for R&D expenditures, we follow the convention and set the missing values to zeros. In the regressions, we include a dummy variable for zero-imputed R&D expenditures.

Table 2
Descriptive statistics.

Variable	Mean	Median	Minimum	Maximum	Std. dev.	No. of obs.
LGBTQ friendliness:						
CEI score	65.84	80.00	−25.00	100.00	34.38	4902
Innovation variables:						
Patents	88.38	1.00	0.00	3791.00	269.89	4902
Citations	778.69	0.00	0.00	63,059.00	3528.49	4902
Originality	185.79	2.00	0.00	8253.00	583.21	4902
Generality	61.02	0.00	0.00	6000.00	284.99	4902
Internationality	73.92	2.00	0.00	4238.00	253.09	4902
Inventor count	118.32	1.12	0.00	3472.44	316.12	4902
Control variables:						
Size	9.36	9.33	4.19	13.59	1.30	4902
Profitability	0.05	0.05	−0.48	0.45	0.07	4902
Cash	0.09	0.07	0.00	0.51	0.08	4902
Leverage	0.65	0.64	0.12	2.11	0.22	4902
Total Q	1.12	0.82	−0.93	12.87	1.17	4902
R&D	0.02	0.00	0.00	0.24	0.03	4902
Capex	0.05	0.04	0.00	0.25	0.04	4902
Employee-friendly	0.06	0.00	0.00	1.00	0.24	4902

The table reports summary statistics for the sample firms. LGBTQ friendliness is measured with the Corporate Equality Index (*CEI score*) constructed by the Human Rights Campaign. The dependent variables are defined as follows: *Patents* is the patent count for a given firm in a given year, *Citations* is the annual total global citation count for the firm's patents registered on the filing year of each citing patent, *Originality* is the number of NBER technological classes spanned by the cited patent, *Generality* is the number of NBER technological classes spanned by the citing patents, *Internationality* is the number of patent assignee countries spanned by the citing patents, and *Inventor count* is the number of individual patent inventors in the firm scaled by the total amount of individual inventors in a given year and multiplied by the average annual total number of inventors. The control variables are defined as follows: *Size* is the logarithm of the firm's total assets, *Profitability* is measured with return on assets which is calculated as the ratio of net income to total assets, *Cash* is cash holdings scaled by total assets, *Leverage* is the ratio of total liabilities to total assets, *Total Q* is the adjusted Tobin's Q that accounts for the firm's intangible capital, *R&D* is research and development expenditures scaled by total assets, *Capex* is capital expenditures scaled by total assets, and *Employee-friendly* is a dummy variable that equals one for firms which are included in the Fortune's list of the 100 Best Companies to Work For in America in a given year.

Table 3
Correlations.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) CEI score														
(2) Patents	0.25*													
(3) Citations	0.22*	0.9*												
(4) Originality	0.22*	0.98*	0.96*											
(5) Generality	0.21*	0.86*	0.95*	0.88*										
(6) Internationality	0.22*	0.95*	0.98*	0.97*	0.95*									
(7) Inventor count	0.27*	0.92*	0.85*	0.89*	0.78*	0.86*								
(8) Size	0.19*	0.38*	0.33*	0.37*	0.31*	0.35*	0.42*							
(9) Profitability	0.06*	0.15*	0.14*	0.15*	0.13*	0.15*	0.15*	0.02						
(10) Cash	0.12*	0.31*	0.27*	0.29*	0.23*	0.27*	0.28*	−0.15*	0.12*					
(11) Leverage	0.00	−0.16*	−0.18*	−0.16*	−0.18*	−0.18*	−0.15*	0.03*	−0.29*	−0.18*				
(12) Total Q	0.13*	0.18*	0.15*	0.16*	0.13*	0.15*	0.21*	0.03	0.46*	0.13*	−0.26*			
(13) R&D	0.15*	0.69*	0.64*	0.67*	0.57*	0.65*	0.69*	0.03	0.14*	0.36*	−0.11*	0.19*		
(14) Capex	−0.03	−0.12*	−0.09*	−0.12*	−0.08*	−0.09*	−0.11*	0.06*	0.03	−0.23*	−0.02	0.03*	−0.21*	
(15) Employee-friendly	0.15*	0.13*	0.14*	0.12*	0.16*	0.15*	0.13*	0.00	0.11*	0.07*	−0.22*	0.25*	0.12*	0.05*

The table reports pairwise correlations between the variables used in the main regressions. LGBTQ friendliness is measured with the Corporate Equality Index (*CEI score*) constructed by the Human Rights Campaign. The dependent variables are defined as follows: *Patents* is the patent count for a given firm in a given year, *Citations* is the annual total global citation count for the firm's patents registered on the filing year of each citing patent, *Originality* is the number of NBER technological classes spanned by the cited patent, *Generality* is the number of NBER technological classes that by the citing patents, *Internationality* is the number of patent assignee countries spanned by the citing patents, and *Inventor count* is the number of individual patent inventors in the firm scaled by the total amount of individual inventors in a given year and multiplied by the average annual total number of inventors. The inverse hyperbolic sine transformation is applied to all dependent variables. The control variables are defined as follows: *Size* is the logarithm of total assets, *Profitability* is measured with return on assets which is calculated as the ratio of net income to total assets, *Cash* is cash holdings scaled by total assets, *Leverage* is the ratio of total liabilities to total assets, *Total Q* is the adjusted Tobin's Q that accounts for the firm's intangible capital, *R&D* is research and development expenditures scaled by total assets, *Capex* is capital expenditures scaled by total assets, and *Employee-friendly* is a dummy variable that equals one for firms which are included in the Fortune's list of the 100 Best Companies to Work For in America in a given year. All variables are winsorized at the 1st and 99th percentiles. *denotes statistical significance at the 0.01 level.

firms, supporting the argument that LGBTQ-supportive policies may enhance the productivity and innovative activity of the firm's employees.

With respect to our control variables, it can be noted from Table 4 that firms with more LGBTQ-friendly employee policies are very different from the ones with less LGBTQ-friendly policies. Most importantly, the results of the *t*-tests indicate that the more LGBTQ-friendly firms are substantially larger, have higher profitability and valuation, invest more in research and development, are more likely to be among the firms with the highest employee satisfaction. Given these differences in firm characteristics and their potentially confounding effects on innovation activity, the univariate results regarding the positive relationship between LGBTQ-friendly employee policies and innovation should be approached cautiously.

Table 4
Univariate tests.

	Less LGBTQ-friendly	More LGBTQ-friendly	Difference in means
Patents	25.11	175.06	149.95***
Citations	148.02	1510.43	1362.41***
Originality	53.45	357.04	303.59***
Generality	11.33	109.68	98.35***
Internationality	17.68	136.00	118.32***
Inventor count	30.33	244.47	214.14***
Size	9.00	9.75	0.75***
Profitability	0.05	0.06	0.01***
Cash	0.08	0.10	0.02***
Leverage	0.65	0.65	0.00
Total Q	0.92	1.29	0.37***
R&D	0.01	0.03	0.02***
Capex	0.05	0.04	−0.01***
Employee-friendly	0.02	0.10	0.08***

The table reports the results of two-tailed *t*-tests for the null hypothesis that there is no difference in the means between more LGBTQ-friendly and less LGBTQ-friendly firms. The subsample of more LGBTQ-friendly firms comprises the firms that have a CEI score of 100 and the subsample of less LGBTQ-friendly firms consists of firms with CEI scores of less than 45. The patent-based measures of innovation intensity and quality are defined as follows: *Patents* is the patent count for a given firm in a given year, *Citations* is the annual total global citation count for the firm's patents registered on the filing year of each citing patent, *Originality* is the number of NBER technological classes spanned by the cited patent, *Generality* is the number of NBER technological classes spanned by the citing patents, *Internationality* is the number of patent assignee countries spanned by the citing patents, and *Inventor count* is the number of individual patent inventors in the firm scaled by the total amount of individual inventors in a given year and multiplied by the average annual total number of inventors. The inverse hyperbolic sine transformation is applied to all dependent variables before the *t*-tests. The control variables are defined as follows: *Size* is the logarithm of total assets, *Profitability* is measured with return on assets which is calculated as the ratio of net income to total assets, *Cash* is cash holdings scaled by total assets, *Leverage* is the ratio of total liabilities to total assets, *Total Q* is the adjusted Tobin's Q that accounts for the firm's intangible capital, *R&D* is research and development expenditures scaled by total assets, *Capex* is capital expenditures scaled by total assets, and *Employee-friendly* is a dummy variable that equals one for firms which are included in the Fortune's list of the 100 Best Companies to Work For in America in a given year. All variables are winsorized at the 1st and 99th percentiles. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

3.2. Main results

We empirically test the hypothesis that LGBTQ-friendly employee policies foster corporate innovation by estimating alternative versions of the following three-way fixed-effects specification:

$$\begin{aligned}\text{Innovation}_{i,t} = {} & \alpha + \beta\text{CEI score}_{i,t-1} + \gamma(\text{Firm-specific controls})_{i,t-1} \\ & + \omega(\text{Industry fixed-effects})_i + \varphi(\text{State fixed-effects})_i \\ & + \tau(\text{Year fixed-effects})_t + \varepsilon_{i,t}\end{aligned} \quad (1)$$

where the dependent variable $Innovation_{i,t}$ is one of the alternative patent-based measures of innovation intensity and quality for firm *i* at time *t*, and *CEI score* is the Corporate Equality Index which is our proxy for LGBTQ friendliness. The set of control variables in Eq. (1) includes *Size*, *Profitability*, *Cash*, *Leverage*, *Total Q*, *R&D*, *Capex*, and *Employee-friendly*. The independent variables in Eq. (1) are lagged by one year in order to alleviate endogeneity concerns and to avoid potential reverse causality from the innovation measures to our independent variables. We include industry and state fixed-effects to control for any systemic variation in innovation intensity and quality across different industries and across the different U.S. states as well as to mitigate potential biases related to omitted variables and unobserved heterogeneity. Moreover, we account for systematic variation in corporate innovation over time by including year fixed-effects in the regressions. All variables in Eq. (1) are winsorized at the 1st and 99th percentiles to moderate the effects of outliers. Throughout the estimations, we use robust standard errors that are adjusted for heteroskedasticity and clustered by firm.

Table 5 reports the estimation results of alternative versions of Eq. (1) with the raw and adjusted patent and patent citation counts as the dependent variables. All four model specifications include the full set of control variables as well as industry, state, and year fixed-effects. As shown in Table 5, the adjusted R^2s indicate a good fit of the estimated regressions.

The estimates in Table 5 provide support for the hypothesis that LGBTQ-supportive employee policies foster corporate innovation. Specifically, the estimated coefficients for *CEI score* are positive and statistically significant at the 1 % level in all four models, suggesting that LGBTQ-friendly firms produce more patents as well as higher-quality

Table 5
Regression results: Patents and patent citations.

	Patents		Citations	
	Raw	Adjusted	Raw	Adjusted
Constant	−1.748**	−1.996**	−1.117	−3.249***
	(−1.97)	(−2.24)	(−1.03)	(−3.68)
CEI score	0.006***	0.006***	0.007***	0.007***
	(4.26)	(4.38)	(3.89)	(4.09)
Size	0.688***	0.619***	0.788***	0.607***
	(12.65)	(11.48)	(11.54)	(8.53)
Profitability	0.310	0.670*	0.007	0.907**
	(0.80)	(1.90)	(0.01)	(2.07)
Cash	0.111***	0.102***	0.079*	0.095**
	(3.17)	(3.11)	(1.71)	(2.39)
Leverage	−0.389**	−0.243	−0.591***	−0.239
	(−2.48)	(−1.62)	(−3.05)	(−1.32)
Total Q	0.260**	0.317***	0.368***	0.463***
	(2.40)	(3.19)	(2.65)	(3.48)
R&D	0.210***	0.182***	0.250***	0.159***
	(10.27)	(9.10)	(9.64)	(6.41)
Capex	0.026	0.015	0.048	−0.034
	(0.44)	(0.27)	(0.65)	(−0.53)
Employee-friendly	0.270	0.280*	0.335	0.236
	(1.62)	(1.78)	(1.55)	(1.03)
Industry fixed-effects	Yes	Yes	Yes	Yes
Period fixed-effects	Yes	Yes	Yes	Yes
State fixed-effects	Yes	Yes	Yes	Yes
No. of observations	4902	4902	4902	4902
Adjusted R^2	0.74	0.70	0.70	0.55

The table reports the estimates of four alternative versions of Eq. (1). LGBTQ friendliness is measured with the Corporate Equality Index (*CEI score*) constructed by the Human Rights Campaign. The dependent variables are defined as follows: $Patents_{Raw}$ is the patent count for a given firm in a given year, $Patents_{Adj}$ is the patent count adjusted for the average number of patents per firm in the same NBER technological class during the patent filing year, $Citations_{Raw}$ is the annual total global citation count for the firm's patents registered on the filing year of each citing patent, and $Citations_{Adj}$ is the firm's citation count adjusted for the citation count per patent for all firms in the same technological class during the patent filing year. The inverse hyperbolic sine transformation is applied to all dependent variables. The control variables are defined as follows: *Size* is the logarithm of total assets, *Profitability* is measured with return on assets which is calculated as the ratio of net income to total assets, *Cash* is cash holdings scaled by total assets, *Leverage* is the ratio of total liabilities to total assets, *Total Q* is the adjusted Tobin's Q that accounts for the firm's intangible capital, *R&D* is research and development expenditures scaled by total assets, *Capex* is capital expenditures scaled by total assets, and *Employee-friendly* is a dummy variable that equals one for firms which are included in the Fortune's list of the 100 Best Companies to Work For in America in a given year. All variables are winsorized at the 1st and 99th percentiles. The *t*-statistics (in parentheses) are based on robust standard errors which are adjusted for heteroskedasticity and are clustered by firm. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

patents. In addition to being statistically significant, the positive association between LGBTQ friendliness and innovation can also be considered economically significant. The magnitudes of the coefficients suggest that a one standard deviation increase in *CEI score* would increase the firm's raw patent count by approximately 20 % and patent citation count by almost 25 %. Regarding the control variables, it can be noted from Table 5 that larger firms with higher market valuation, cash holdings, and R&D investments are associated with more patents and patent citations.

We next shift the focus from the number of patents and patent citations to three distinct measures of innovation quality: patent originality, generality, and internationality. Table 6 reports the estimation results of six alternative versions of Eq. (1) with the raw and adjusted *Originality*, *Generality*, and *Internationality* as the dependent variables. The adjusted R^2s indicate that our fixed-effects regressions explain about 64–73 % of the variation in the raw patent quality measures.

As can be seen from Table 6, the coefficient estimates for *CEI score* are positive and statistically highly significant in all six models. Thus, similar to Table 5, the regressions suggest that LGBTQ friendliness is positively associated with corporate innovation. The positive effect of LGBTG-friendly policies appears slightly larger in magnitude when *Originality* and *Internationality* are used as the dependent variables. The estimates of Models 1 and 5 suggest that a one standard deviation increase in *CEI score* increases the originality and internationality of the firm's patents by more than 20 %. Consistent with the regressions reported in Table 5, the coefficients for the control variables indicate that innovation quality is significantly positively associated with *Size*, *Cash*, *Total Q*, and *R&D* while being negatively related to *Leverage*. In addition, *Generality* appears weakly positively associated with *Employee-friendly* in Model 3.

Finally, we proceed by regressing the firm-level concentration of individual innovative employees on *CEI score*. The estimates of the regressions with the raw and memory-adjusted inventor counts as the dependent variables are presented in Table 7. Again, the coefficient estimates for *CEI score* are positive and statistically significant at the 1 % level, and thereby provide further evidence to suggest that LGBTQ friendliness is positively associated with corporate innovation and the distribution of innovative human capital across firms. The magnitudes of the estimated coefficients in Table 7 indicate that a one standard deviation increase in *CEI score* increases firm-level innovative talent by about 20 %. Thus, the positive relationship between LGBTQ-friendly employee policies and the concentration of innovative talent can be considered economically meaningful in addition to being statistically significant.

Collectively, the regression results presented in Tables 5, 6, and 7 support the hypothesis that LGBTQ-friendly firms are more innovative. Our empirical findings provide strong evidence that LGBTQ friendliness is positively associated with the patent-based measures of innovation intensity and quality after controlling for firm attributes such as size, profitability, R&D intensity, and overall employee satisfaction as well as for any systemic differences across different industries and states. The regressions show that LGBTQ-friendly firms produce significantly more patents, have more patent citations and higher patent quality as well as a higher concentration of individual inventors as employees. Regardless of the innovation measure used, the effect of LGBTQ-friendly employee policies on corporate innovation is economically meaningful in addition to being statistically significant. In general, these findings can be interpreted to indicate that enhanced innovation intensity and quality are among the potential channels through which LGBTQ-supportive policies may improve firm performance as documented in Shan et al. (2017), Pichler et al. (2018), Jiraporn et al. (2019), and Fatmy et al. (2022).

3.3. Endogeneity concerns

We next discuss the issues that could confound causal interpretation of our results and then proceed to address potential endogeneity concerns with two-stage instrumental variable (IV) regressions, propensity score matching (PSM), and a difference-in-differences analysis. As with any observational study, we acknowledge that omitted variables, reserve causality, selection bias, and functional form misspecification are potential sources of endogeneity that could bias our main regressions. For instance, it is possible that an omitted or unobservable attribute is correlated with both the firm-level LGBTQ friendliness and the patent-based measure of innovation, thereby creating an artificial linkage between the two variables. While concerns about an omitted variable cannot be decisively eliminated, we follow Larcker and Rusticus (2010) in assessing the extent of potential omitted variable bias. Specifically, we compute Impact Threshold of a Confounding Variable ("ITCV"; Frank, 2000) between CEI score and our five different dependent variables, and compare the magnitude of the ITCVs with the ones for our control variables. In untabulated results, we find that the ITCV for CEI score is generally larger than the ones for all the control variables, with the exception of firm size. With respect to firm size, one might argue that it is unlikely that there exists an omitted variable that is as important as firm size in determining a firm's innovative performance, given that we already include an extensive set of control variables motivated by prior research. These results lead us to conclude that while omitted variable bias cannot completely dismissed in our empirical specifications, such a variable would need to be rather large in statistical impact in order to overturn our results. Moreover, we have attempted to control for unobserved firm heterogeneity by including industry, state, and year fixed-effects in our regressions. The use of PSM as an alternative estimation approach further addresses any omitted variable concerns.

Based on the theoretical arguments presented in the HRM literature, it is unlikely that our main results are driven by reverse causality. Moreover, given the fact that patents are granted approximately two years after the initial filing and that we use lagged independent variables in the regressions, reverse causality in our empirical setting would rather counterintuitively imply that higher innovation intensity and quality at time $t + 2$ would lead to more LGBTQ-friendly corporate policies at t-1. Nevertheless, we utilize the instrumental variable approach to address potential endogeneity concerns arising from reverse causality.

We identify two potential sources of selection bias in our empirical setting. First, our measure of LGBTQ friendliness, *CEI score*, would suffer from a voluntary disclosure bias if only firms that have implemented LGBTQ-friendly policies or acknowledge the importance of diversity management were to respond to the HRC's surveys. However, the observed CEI ranges from −25 to 100 with a sample standard deviation of 35, rendering this scenario unlikely. We nevertheless address the issue of voluntary disclosure in our additional tests. Second, it is possible that if only firms with non-zero patent counts are included in the sample, our regressions would yield false-positive results (see Koh et al., 2022). Therefore, we follow the convention in the prior innovation literature and assume that firms produce zero patents if their patent information is missing.

Finally, we acknowledge that an incorrect functional form of the regression specification can lead to a correlation between the residual term and the patent-based innovation measures. More specifically, the coefficient estimates for *CEI score* in our regressions may be biased if the critical assumption of model linearity is violated (Greene, 2018). We address these concerns to some degree by including three-way fixed effects in our main regressions, which are supposed to absorb the effects of potential nonlinearities across industries, states, and years that could be driving the results. Furthermore, we alleviate any potential model misspecification concerns by utilizing the PSM approach which relaxes linearity assumptions in a multiple regression framework.

In the following, we proceed by estimating two-stage IV regressions to mitigate reverse causality concerns and to establish a causal linkage between LGBTQ-friendly policies and innovation. Because the choice of the instrumental variables admittedly is arbitrary and easy to criticize,

Table 6
Regression results: Patent originality, generality, and internationality.

	Originality		Generality		Internationality	
	Raw	Adjusted	Raw	Adjusted	Raw	Adjusted
Constant	−1.544*	−2.724***	−0.986	−2.366***	−1.461*	−2.554***
	(−1.76)	(−3.48)	(−1.39)	(−4.62)	(−1.75)	(−3.61)
CEI score	0.007***	0.007***	0.005***	0.004***	0.006***	0.006***
	(4.03)	(4.43)	(3.57)	(3.40)	(4.13)	(4.10)
Size	0.726***	0.662***	0.538***	0.332***	0.630***	0.479***
	(12.45)	(11.92)	(10.78)	(7.15)	(12.15)	(8.78)
Profitability	0.223	0.703*	0.006	0.467*	0.098	0.594*
	(0.52)	(1.75)	(0.02)	(1.83)	(0.27)	(1.72)
Cash	0.095**	0.086**	0.030	0.039*	0.062*	0.070**
	(2.49)	(2.39)	(0.93)	(1.69)	(1.86)	(2.40)
Leverage	−0.454**	−0.357**	−0.379***	−0.053	−0.434***	−0.214
	(−2.57)	(−2.08)	(−2.71)	(−0.51)	(−2.91)	(−1.60)
Total Q	0.262**	0.293**	0.278***	0.310***	0.248**	0.352***
	(2.17)	(2.45)	(2.77)	(3.50)	(2.36)	(3.54)
R&D	0.228***	0.207***	0.154***	0.059***	0.193***	0.124***
	(10.53)	(9.83)	(8.52)	(3.84)	(9.89)	(6.58)
Capex	0.018	0.035	0.033	−0.025	0.041	−0.010
	(0.28)	(0.61)	(0.62)	(−0.64)	(0.73)	(−0.19)
Employee-friendly	0.260	0.227	0.368*	0.223	0.288	0.194
	(1.47)	(1.26)	(1.94)	(1.34)	(1.64)	(1.08)
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Period fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
State fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	4902	4902	4902	4902	4902	4902
Adjusted R^2	0.73	0.66	0.64	0.41	0.71	0.56

The table reports the estimates of six alternative versions of Eq. (1). LGBTQ friendliness is measured with the Corporate Equality Index (*CEI score*) constructed by the Human Rights Campaign. The dependent variables are defined as follows: $Originality_{Raw}$ is the number of NBER technological classes spanned by the cited patent, $Generality_{Raw}$ is the number of NBER technological classes spanned by the citing patents, and $Internationality_{Raw}$ is the number of patent assignee countries spanned by the citing patents. $Originality_{Adj}$, $Generality_{Adj}$, and $Internationality_{Adj}$ are the corresponding raw measures adjusted for the average annual measures for the technological class of the cited patent. The inverse hyperbolic sine transformation is applied to all dependent variables. The control variables are defined as follows: *Size* is the logarithm of total assets, *Profitability* is measured with return on assets which is calculated as the ratio of net income to total assets, *Cash* is cash holdings scaled by total assets, *Leverage* is the ratio of total liabilities to total assets, *Total Q* is the adjusted Tobin's Q that accounts for the firm's intangible capital, *R&D* is research and development expenditures scaled by total assets, *Capex* is capital expenditures scaled by total assets, and *Employee-friendly* is a dummy variable that equals one for firms which are included in the Fortune's list of the 100 Best Companies to Work For in America in a given year. The *t*-statistics (in parentheses) are based on robust standard errors which are adjusted for heteroskedasticity and are clustered by firm. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

we use three alternative instruments for *CEI score* in the first-stage regressions. With our first causal identification strategy, we exploit the staggered passage of state-level Employment Non-Discrimination Acts (ENDA) for increased protection of LGBTQ employees in the workplace. The passage of legislation that prohibits employment discrimination based on sexual orientation or gender identity represents exogenous, positive shocks to firm-level implementation of LGBTQ-friendly policies while it arguably should not have any direct independent influence on the number of patents and patent citations of individual firms. Because the enactment of the ENDAs vary by state over time, our instrument for the firm-level LGBTQ friendliness is a dummy variable that takes the value of one for firms headquartered in the ENDA states for the post-enactment years, and zero otherwise.

The second instrumental variable we use is the annual total number of employment discrimination charges filed under Title VII in the firm's headquarter state relative to the LGBTQ population in that state. In a series of legal cases starting from 1989, the Supreme Court and the Equal Employment Opportunity Commission (EEOC) have ruled that employer discrimination based on employee gender identity and "sex-stereotyping" is unlawful under Title VII of the Civil Rights Act of 1964. Given that state-level trends in employment discrimination can be considered to reflect local attitudes towards diversity and equality in general, and increasingly towards the LGBTQ community in specific, we posit that the amount of Title VII charges relative to the LGBTQ population in a given state is negatively associated with LGBTQ friendliness while it should not have any conceptual relation to innovation intensity and quality of individual firms.[11] Finally, following Jiraporn et al. (2019), Chintrakarn et al. (2020), and Fatmy et al. (2022), we use the annual percentage of the state population that self-identifies as LGBTQ as the third instrument for *CEI score*. As argued by Jiraporn et al. (2019), firms headquartered in states with larger LGBTQ populations are likely to have more LGBTQ-friendly corporate policies and practices. In addition to using the three alternative instrumental variables individually, we also estimate a two-stage IV model in which all three instruments are used simultaneously in the first-stage regressions.

Table 8 presents the estimates of the instrumental variable regressions. In addition to the instrumental variable, the first-stage regressions reported in Panel A include the same set of control variables as our main regressions. The coefficient estimates for the three alternative instrumental variables are statistically significant at the 1 % level when used individually and also when used simultaneously. As expected, the first-stage regressions indicate that the enactment of ENDAs and LGBTQ population are positively associated with the implementation of LGBTQ-friendly corporate policies, while the amount of Title VII charges at the

[11] Although transgender discrimination was ruled under Title VII already in the cases of *PriceWaterhouse v. Hopkins* (1989) and *Maffei v. Kolaeton Industries* (1995), the Supreme Court rulings regarding same-sex marriage and the position taken by the EEOC that LGBTQ discrimination was sex discrimination under Title VII came fully into place with the case *Macy v. Holder* (2012).

Table 7
Regression results: Inventor count.

	Raw inventor count	Adjusted inventor count
Constant	−2.861***	−1.392
	(−2.83)	(−1.37)
CEI score	0.006***	0.005***
	(3.69)	(3.25)
Size	0.800***	0.750***
	(13.77)	(12.90)
Profitability	0.231	0.625
	(0.61)	(1.61)
Cash	0.123***	0.132***
	(3.16)	(3.36)
Leverage	−0.387**	−0.270
	(−2.35)	(−1.54)
Total Q	0.376***	0.223*
	(3.06)	(1.74)
R&D	0.213***	0.213***
	(8.70)	(8.73)
Capex	0.002	0.046
	(0.03)	(0.57)
Employee-friendly	0.297*	0.269*
	(1.86)	(1.68)
Industry fixed-effects	Yes	Yes
Period fixed-effects	Yes	Yes
State fixed-effects	Yes	Yes
No. of observations	4902	4902
Adjusted R^2	0.73	0.78

The table reports the estimates of two alternative versions of Eq. (1). LGBTQ friendliness is measured with the Corporate Equality Index (*CEI score*) constructed by the Human Rights Campaign. The dependent variables are defined as follows: *Inventor count*$_{Raw}$ is the number of individual patent inventors in the firm scaled by the total amount of individual inventors in a given year and multiplied by the average annual total number of inventors and *Inventor count*$_{Adj}$ is the firm's memory adjusted inventor count scaled by the total amount of individual inventors in a given year and multiplied by the average annual total number of inventors. The inverse hyperbolic sine transformation is applied to the dependent variables. The control variables are defined as follows: *Size* is the logarithm of total assets, *Profitability* is measured with return on assets which is calculated as the ratio of net income to total assets, *Cash* is cash holdings scaled by total assets, *Leverage* is the ratio of total liabilities to total assets, *Total Q* is the adjusted Tobin's Q that accounts for the firm's intangible capital, *R&D* is research and development expenditures scaled by total assets, *Capex* is capital expenditures scaled by total assets, and *Employee-friendly* is a dummy variable that equals one for firms which are included in the Fortune's list of the 100 Best Companies to Work For in America in a given year. All variables are winsorized at the 1st and 99th percentiles. The *t*-statistics (in parentheses) are based on robust standard errors which are adjusted for heteroskedasticity and are clustered by firm. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

state level is negatively related to firm-level LGBTQ friendliness. The partial *F*-statistics of the first-stage regressions exceed the critical values suggested by Stock et al. (2002), suggesting that our instrumental variable estimates should not be plagued by a weak-instrument problem. The untabulated first-stage estimates for the control variables indicate that LGBTQ friendliness is significantly positively associated with *Size*, *Cash*, *R&D*, and *Employee-friendly*.

Panel B of Table 8 reports the estimates of the second-stage regressions in which the alternative patent-based measures of innovation intensity and quality are regressed on the instrumented *CEI score* and the firm-specific control variables. Overall, the estimates of the second-stage regressions indicate that LGBTQ-friendly policies have a positive influence on corporate innovation. Regardless of the instrument used, the estimated coefficients for the instrumented *CEI score* are positive and statistically significant in the second-stage regressions with *Patents*, *Citations*, *Generality*, and *Internationality* as the dependent variables. Moreover, the coefficients for the instrumented CEI score are positive and significant also in the regressions with *Originality* and *Inventor count* as the dependent variables when the staggered enactment of ENDAs is used as the instrument and when all three instrumental variables are used simultaneously. Panel B of Table 8 also reports the Hansen J-statistic from the IV regressions that use all three instruments. The test statistic is insignificant ($p > 0.10$) across all specifications, indicating that we cannot reject the null that the instruments are valid. Overall, our two-stage IV regressions suggest that LGBTQ-friendly firms are more innovative even after controlling for potential endogeneity. With respect to the control variables, the estimates of the instrumental variable regressions are broadly consistent with our main regressions in Tables 5–7, and indicate that innovation intensity and quality are positively associated with *Size*, *Cash*, *Total Q*, and *R&D*.

We utilize propensity score matching as the second approach to alleviating endogeneity concerns. The univariate tests in Table 4 as well as the first-stage estimates of our IV regressions indicate that firms with more LGBTQ-friendly employee policies are very different from the ones with less LGBTQ-friendly policies. Among other differences, LGBTQ-friendly firms are substantially larger, invest more in research and development, and are more likely to be among the firms with the highest employee satisfaction. Given the observed differences in firm characteristics, we construct a matched-firm sample in which the most LGBTQ-friendly firms with a maximum CEI score of 100 are matched with less LGBTQ-friendly firms which are as identical as possible in terms of observable firm attributes other than LGBTQ friendliness and innovativeness.

We use all the control variables included in Eq. (1) together with industry and year dummies to estimate propensity scores for the sample firms and then use these scores to identify a matched sample of less LGBTQ-friendly firms that are statistically as similar as possible to the most LGBTQ-friendly firms included in our sample. If the only observable difference between the matched firms is their *CEI score*, we should not observe any differences in the patent-based measures of innovation intensity and quality unless LGBTQ friendliness affects corporate innovation. We utilize one-to-one nearest neighbor matching without replacement and require that the maximum difference between the propensity score of each treatment firm and that of its matched control firm does not exceed 0.1 standard deviations of the propensity scores.[12] After identifying matching firms for the most LGBTQ-friendly firms, we re-estimate alternative versions of Eq. (1) using the propensity score matched sample of firms.

The regression results based on the propensity score matched sample are presented in Table 9. Column I reports the pre-matching regression results with *CEI score* as the dependent variable, and Column II reports the results of the post-matching regression. The matching diagnostics suggest that the matched firms are sufficiently similar to the treatment firms. When the probit model underlying the propensity score matching is re-estimated using the matched-firm sample, the post-matching pseudo R^2 is about 1 % and the LR chi-square becomes insignificant, suggesting that all of the coefficients are simultaneously equal to zero. Moreover, the propensity scores of the treatment and matched firms have a mean difference of 0.001 and a mean percentage difference of 0.13 %. The post-matching standardized mean difference (SMD) also drops from a significant 59 % to an insignificant 15.4 %, below the 20 % threshold of acceptance. Overall, the matching diagnostics indicate that the propensity score matching effectively eliminates the observable differences between the most LGBTQ-friendly firms and their less LGBTQ-friendly matched counterparts.

As can be noted from Table 9, the coefficients for *CEI score* are positive and statistically highly significant regardless of the dependent variable. Thus, the regression results based on the propensity score

[12] As an alternative matching procedure, we apply multivariate Mahalanobis distance matching. The regression results based on Mahalanobis-matched sample are consistent with the estimates based on PSM.

Table 8
Instrumental variable regressions.

Panel A. First-stage instrumental variable regression models for *CEI Score* using alternative instruments

Instrument	IV model (1)	IV model (2)	IV model (3)	IV model (4)
ENDA enactment	12.49***			3.282***
	(5.17)			(3.02)
Title VII charges		−28.77***		−5.445***
		(−4.91)		(−4.85)
LGBTQ population			35.98***	5.413***
			(5.43)	(3.54)
Control variables	Yes	Yes	Yes	Yes
Industry fixed-effects	Yes	Yes	Yes	Yes
Period fixed-effects	Yes	Yes	Yes	Yes
No. of observations	4902	4902	4902	4902
Adjusted R^2	0.255	0.251	0.257	0.267
Shea's partial R^2	0.035	0.031	0.038	0.052
Partial *F*-statistic	26.75	24.12	29.47	13.90

Panel B. Second-stage instrumental variable regressions based on instrumented *CEI Score*

Instrumental variable model	Patents	Citations	Originality	Generality	Internationality	Inventor count
(1) ENDA enactment	0.019**	0.023**	0.017*	0.016**	0.019**	0.028**
	(2.02)	(2.15)	(1.72)	(2.56)	(2.39)	(2.27)
(2) Title VII charges	0.020**	0.024**	0.016	0.013**	0.021**	0.018
	(1.96)	(2.09)	(1.52)	(2.00)	(2.49)	(1.50)
(3) LGBTQ population	0.020**	0.026***	0.020**	0.012**	0.021***	0.013
	(2.43)	(2.67)	(2.34)	(2.20)	(2.89)	(1.30)
(4) All instruments	0.020**	0.025***	0.018**	0.014***	0.020***	0.019**
	(2.51)	(2.81)	(2.22)	(2.77)	(3.10)	(1.99)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Period fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	4902	4902	4902	4902	4902	4902
Adjusted R^2	0.643	0.473	0.616	0.326	0.472	0.741
Wald χ^2-statistic	1717.16	981.34	1697.97	577.68	852.38	3194.50
Hansen's J statistic (4)	0.184	0.338	0.371	0.081	0.522	2.282

The table reports the estimates of two-stage instrumental variable regressions. LGBTQ friendliness is measured with the Corporate Equality Index (*CEI score*) constructed by the Human Rights Campaign. Three alternative instruments for *CEI score* are used in the first-stage regressions: *ENDA enactment* is a staggered dummy variable that equals one for firms headquartered in the states that have adopted employment non-discrimination acts, *Title VII charges* is the annual total number of employment discrimination charges filed under Title VII relative to the LGBTQ population in the firm's headquarter state, and *LGBTQ population* is the annual percentage of the state population that self-identifies as LGBTQ. The dependent variables in the second-stage regressions are defined as follows: *Patents* is the patent count for a given firm in a given year, *Citations* is the annual total global citation count for the firm's patents registered on the filing year of each citing patent, *Originality* is the number of NBER technological classes spanned by the cited patent, *Generality* is the number of NBER technological classes spanned by the citing patents, *Internationality* is the number of patent assignee countries spanned by the citing patents, and *Inventor count* is the number of individual patent inventors in the firm scaled by the total amount of individual inventors in a given year and multiplied by the average annual total number of inventors. The inverse hyperbolic sine transformation is applied to the dependent variables. The control variables are defined as follows: *Size* is the logarithm of total assets, *Profitability* is measured with return on assets which is calculated as the ratio of net income to total assets, *Cash* is cash holdings scaled by total assets, *Leverage* is the ratio of total liabilities to total assets, *Total Q* is the adjusted Tobin's Q that accounts for the firm's intangible capital, *R&D* is research and development expenditures scaled by total assets, *Capex* is capital expenditures scaled by total assets, and *Employee-friendly* is a dummy variable that equals one for firms which are included in the Fortune's list of the 100 Best Companies to Work For in America in a given year. All variables are winsorized at the 1st and 99th percentiles. The *t*-statistics (in parentheses) are based on robust standard errors which are adjusted for heteroskedasticity and are clustered by firm. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

matched sample demonstrate that LGBTQ-friendly firms are more innovative and produce more patents, have more patent citations and higher quality patents, and have a higher number of individual inventors as employees even after controlling for any endogenous selection on observed firm characteristics. Broadly consistent with our main regressions, the estimates in Table 9 suggest that a one standard deviation increase in *CEI score* would increase the firm's patent count by about 27 % and patent citations by over 30 %.

Finally, we address potential endogeneity concerns through a difference-in-differences analysis centered on the 2015 *Obergefell v. Hodges* Supreme Court ruling, which legalized same-sex marriage across all U.S. states. Specifically, we examine the three-way interaction between firms with above-average pre-ruling CEI scores (*High CEI*), states that did not recognize same-sex marriage prior to the ruling (*No Equality*), and the post-ruling period (*Post*).[13] The results of the DiD regressions are presented in Table 10. The estimated coefficient for the three-way interaction *High CEI* × *No Equality* × *Post* is positive and statistically significant in both regressions. Thus, the estimates suggest that the Obergefell ruling significantly increased corporate innovation in states that previously did not recognize same-sex marriage, but only among firms that had above-average CEI scores prior to the ruling. In

[13] Data on the state-level legality of same-sex marriage prior to *Obergefell v. Hodges* is obtained from the Pew Research Center: https://www.pewresearch.org/religion/2015/06/26/same-sex-marriage-state-by-state-1/

Table 9
Propensity score matching.

Variable	Pre-matching	Post-matching	Patents	Citations	Originality	Generality	Internationality	Inventor count
Constant	−4.012***	−0.022	−0.650	−2.793**	−1.429	−2.332***	−2.287***	−0.270
	(−10.34)	(−0.02)	(−0.68)	(−2.47)	(−1.60)	(−3.55)	(−2.75)	(−0.27)
CEI score			0.008***	0.010***	0.008***	0.005***	0.007***	0.008***
			(4.68)	(4.24)	(4.58)	(3.41)	(4.46)	(3.84)
Size	0.318***	0.032	0.689***	0.744***	0.766***	0.428***	0.598***	0.800***
	(16.26)	(0.56)	(9.56)	(7.59)	(10.33)	(6.46)	(8.16)	(10.39)
Profitability	0.602**	0.366	0.570	0.844	0.386	0.390	0.732	−0.463
	(1.99)	(0.62)	(0.80)	(0.88)	(0.49)	(0.69)	(1.05)	(−0.53)
Cash	0.155***	−0.052	0.217***	0.192**	0.201***	0.083*	0.148***	0.203***
	(7.48)	(−0.99)	(3.63)	(2.53)	(3.12)	(1.88)	(2.68)	(3.03)
Leverage	0.014	0.064	−0.508**	−0.617**	−0.602***	−0.189	−0.470**	−0.401*
	(0.22)	(0.37)	(−2.42)	(−2.34)	(−2.59)	(−1.17)	(−2.40)	(−1.66)
Total Q	−0.100*	0.039	0.188	0.390*	0.161	0.362**	0.291*	0.219
	(−1.74)	(0.25)	(1.21)	(1.81)	(0.95)	(2.35)	(1.86)	(1.22)
R&D	0.031***	0.004	0.156***	0.139***	0.180***	0.055**	0.110***	0.191***
	(4.32)	(0.22)	(5.65)	(3.99)	(6.88)	(2.55)	(4.18)	(6.05)
Capex	−0.062**	0.009	0.138	0.143	0.170*	0.093	0.124	0.169
	(−2.17)	(0.12)	(1.60)	(1.34)	(1.79)	(1.46)	(1.52)	(1.39)
Employee-friendly	0.516***	−0.094	0.230	0.271	0.083	0.179	0.182	0.336
	(6.00)	(−0.42)	(1.33)	(1.03)	(0.47)	(0.92)	(0.97)	(1.50)
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Period fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	4898	2849	2019	2019	2019	2019	2019	2019
Adjusted R^2	0.17	0.010	0.69	0.53	0.66	0.39	0.55	0.74
PSM diagnostics:								
Pre-matching pseudo R^2	0.167							
Pre-matching LR chi-square	993.94***							
Post-matching pseudo R^2	0.010							
Post-matching LR chi-square	20.00							
Post-matching mean difference	0.001							
Post-matching max difference	0.049							
Pre-matching SMD	59.1*							
Post-matching SMD	15.4							
Post-matching mean % difference	0.126							
Post-matching max % difference	5.272							

The table reports the estimates of five alternative versions of Eq. (1) based on a propensity score matched sample of firms. LGBTQ friendliness is measured with the Corporate Equality Index (*CEI score*) constructed by the Human Rights Campaign. We utilize propensity score matching to build a matched-firm sample in which the most LGBTQ-friendly firms with a CEI score of 100 are matched with less LGBTQ-friendly firms which are as similar as possible in terms of the control variables. The dependent variables are defined as follows: *Patents* is the patent count for a given firm in a given year, *Citations* is the annual total global citation count for the firm's patents registered on the filing year of each citing patent, *Originality* is the number of NBER technological classes spanned by the cited patent, *Generality* is the number of NBER technological classes spanned by the citing patents, *Internationality* is the number of patent assignee countries spanned by the citing patents, and *Inventor count* is the number of individual patent assignees in the firm scaled by the total amount of individual inventors in a given year and multiplied by the average annual total number of inventors. The inverse hyperbolic sine transformation is applied to the dependent variables. The control variables are defined as follows: *Size* is the logarithm of total assets, *Profitability* is measured with return on assets which is calculated as the ratio of net income to total assets, *Cash* is cash holdings scaled by total assets, *Leverage* is the ratio of total liabilities to total assets, *Total Q* is the adjusted Tobin's Q that accounts for the firm's intangible capital, *R&D* is research and development expenditures scaled by total assets, *Capex* is capital expenditures scaled by total assets, and *Employee-friendly* is a dummy variable that equals one for firms which are included in the Fortune's list of the 100 Best Companies to Work For in America in a given year. All variables are winsorized at the 1st and 99th percentiles. The *t*-statistics (in parentheses) are based on robust standard errors which are adjusted for heteroskedasticity and are clustered by firm. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

contrast, less LGBTQ-friendly firms in these same newly-treated states, captured by *Post* × *No Equality* interaction term, are not associated with changes in innovation following the ruling. A pairwise marginal effects analysis (not tabulated for brevity) confirms that firm-level LGBTQ friendliness prior to the ruling decisively moderates the ruling's benefits for innovation. In newly-equal states, firms with high CEI scores experienced a 97 % increase in the number of patents and a 75 % increase in patent citations post-2015 relative to high CEI firms in already-equal states, while firms with low CEI scores do not exhibit significant changes in innovation. These results suggest that external legislative changes contribute to innovation outcomes only when complemented with firms' pre-existing LGBTQ-inclusive practices.

3.4. Additional tests

We conduct a number of additional tests in order to ensure that our empirical findings are robust to alternative model specifications and estimation techniques, different sample restrictions, and the inclusion of additional controls. The results of these robustness checks are summarized in Table 11. The six numerical columns show the estimated coefficients for *CEI score* from 12 alternative specifications with the adjusted measures of innovation intensity and quality used as the dependent variables. For convenience, the first row of the table (Specification 0) summarizes the baseline estimation results from Tables 5–7.

First, we examine whether our results are driven by the states with very high levels of innovation activity. For this purpose, we re-estimate the regressions using a sample that excludes all firms headquartered in California, New York, Washington, Illinois, and Massachusetts. As

Table 10
Difference-in-differences (DiD) analysis: The effects of the 2015 U.S. Supreme court ruling on Obergefell v. Hodges.

	$Patents_{Adj}$	$Citations_{Adj}$
Constant	−1.446	−1.537*
	(−1.48)	(−1.68)
Post	−0.995***	−0.916***
	(−7.50)	(−4.67)
High CEI	0.903***	0.841***
	(4.25)	(3.13)
Post × High CEI	−0.649***	−0.605**
	(−4.51)	(−2.49)
No Equality	0.372	0.412
	(1.33)	(1.45)
No Equality × High CEI	−0.435	−0.267
	(−1.23)	(−0.68)
Post × No Equality	−0.165	−0.177
	(−0.75)	(−0.60)
Post × No Equality × High CEI	0.875**	0.701*
	(2.51)	(1.78)
Size	0.565***	0.534***
	(7.09)	(5.62)
Profitability	0.591*	1.119***
	(1.64)	(2.93)
Cash	0.163***	0.184***
	(3.00)	(3.42)
Leverage	−0.558***	−0.584***
	(−2.64)	(−2.78)
Total Q	0.093	0.207**
	(0.71)	(1.33)
R&D	0.118***	0.094***
	(7.78)	(4.52)
Capex	0.063	0.026
	(0.87)	(0.30)
Employee-friendly	0.005	0.005
	(1.72)	(1.33)
Industry fixed-effects	Yes	Yes
No. of observations	4236	4235
Adjusted R^2	0.507	0.348

This table reports the results of the difference-in-differences analysis of adjusted patent and citation counts for firms located in states that did not legally recognize same-sex marriage before the 2015 U.S. Supreme Court ruling on Obergefell v. Hodges. *Post* is a dummy variable that equals one for the post-ruling years and zero for the pre-ruling years. *No Equality* is a dummy variable that equals one for firms headquartered in states that did not legally recognize same-sex marriage before the 2015 Supreme Court ruling. *High CEI* is a dummy variable that equals one for firms with above-average pre-ruling CEI scores. The control variables are defined as follows: *Size* is the logarithm of total assets, *Profitability* is measured with return on assets which is calculated as the ratio of net income to total assets, *Cash* is cash holdings scaled by total assets, *Leverage* is the ratio of total liabilities to total assets, *Total Q* is the adjusted Tobin's Q that accounts for the firm's intangible capital, *R&D* is research and development expenditures scaled by total assets, *Capex* is capital expenditures scaled by total assets, and *Employee-friendly* is a dummy variable that equals one for firms which are included in the Fortune's list of the 100 Best Companies to Work For in America in a given year. All variables are winsorized at the 1st and 99th percentiles. The *t*-statistics (in parentheses) are based on robust standard errors which are adjusted for heteroskedasticity and are clustered by state. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

shown in Table 11, the coefficient estimates for *CEI score* remain almost unchanged in Specification 1, and therefore, we can conclude that the positive association between LGBTQ friendliness and innovation is not induced by the firms located in the most innovative states. If anything, the positive effect of LGBTQ-friendly policies on *Citations*, *Originality*, and *Internationality* appears larger in magnitude when the most innovative states are excluded.

Second, given that regional differences in socio-political norms and attitudes towards sexual minorities may potentially influence the linkage between LGBTQ-supportive policies and corporate innovation, we next investigate the possibility that LGBTQ friendliness is positively associated with innovation activity only in progressive, more liberal U.S. states. For this purpose, we exploit state-level data on religiousness and the U.S. presidential election results to identify and exclude firms located in the most liberal states.[14] When the regressions are re-estimated using a sample that excludes firms located in the most liberal states (Specification 2), the coefficients for *CEI score* remain positive and are statistically significant at the 1 % level. As an alternative approach, we also re-estimate the regressions using a sample that excludes firms located in the most conservative states (Specification 3). Once again, the coefficients for *CEI score* are positive and highly significant. The estimated coefficients are slightly larger in magnitude when the firms located in the most conservative and religious states are excluded, suggesting that the positive effect of LGBTQ-friendly policies on corporate innovation is more pronounced for firms that are headquartered in more liberal states.

Third, to further ensure that our findings are not induced by state-level policies, we re-estimate the regressions using a sample from which all firms headquartered in the states with the strongest employment non-discrimination acts have been excluded.[15] The regression results based on this constrained sample (Specification 4) are consistent with our main findings. As can be noted from Table 11, the positive and significant coefficients for *CEI score* become slightly larger in magnitude in the regressions with *Citations*, *Originality*, and *Internationality* as the dependent variables when the firms located in the strongest ENDA states are excluded from the sample.

Fourth, we address potential industry biases related to the Corporate Equality Index employed as the proxy for firm-level LGBTQ friendliness. Even though our patent-based corporate innovation measures are adjusted for differences across technological classes and we have also controlled for industry fixed-effects in our main regressions, our findings may nevertheless be influenced by cross-industry differences in social progressiveness and attitude towards sexual minorities. These differences are also reflected in the mean CEI scores in our sample which vary considerably across industries. To further address potential industry effects, we estimate industry-adjusted CEI scores for each firm as the residual term from regressing *CEI score* on industry dummies. We then re-estimate our main regressions with the industry-adjusted CEI score as the test variable of interest. As can be seen from Table 11, the estimates of these additional regressions (Specification 5 in Table 11) are consistent with the baseline results. Most importantly, the coefficients for the industry-adjusted CEI score are positive and statistically significant regardless of the innovation measure used as the dependent variable. Thus, we conclude that our results should not be driven by cross-industry differences in LGBTQ friendliness.

Fifth, the CEI would suffer from a voluntary disclosure bias if firms that have implemented LGBTQ-friendly corporate policies or acknowledge the importance of diversity management were more likely to respond to the HRC's survey. Since 2011, the HRC has constructed the CEI also for firms that have not responded to the survey, thereby inflicting an inconsistency in the constituent firms. The firms with non-voluntary CEI scores constitute approximately 11 % of the firm-year observations in our sample over the period 2011–2017. To ascertain that our results are not affected by the non-voluntary CEI scores, we re-estimate the regressions using a subsample from which all firm-year observations with non-voluntary CEI scores have been excluded. The estimates based on this constrained sample (Specification 6) are very

[14] Following Fatmy et al. (2022), we define a firm to be located in a liberal state if the Democratic candidate won the latest presidential election in that state with a margin of at least 5 % and less than one-third of the state population consider themselves to be highly religious.

[15] The constrained sample excludes all firms headquartered in California, Colorado, Connecticut, Hawaii, Illinois, Iowa, Maine, Massachusetts, Nevada, New Mexico, New Jersey, Oregon, Rhode Island, Vermont, Washington, and Washington, D.C.

Table 11
Robustness checks.

Specification	Patents	Citations	Originality	Generality	Internationality	Inv. count
S0. The baseline results from Tables 5–7	0.006***	0.007***	0.007***	0.004***	0.006***	0.005***
S1. Exclude the five most innovative states	0.006***	0.008***	0.007***	0.004***	0.006***	0.005***
S2. Exclude the most liberal states	0.005***	0.007***	0.006***	0.003***	0.005***	0.005***
S3. Exclude most conservative states	0.006***	0.008***	0.007***	0.004***	0.006***	0.005***
S4. Exclude strongest ENDA states	0.006***	0.008***	0.008***	0.004***	0.006***	0.005***
S5. Use industry-adjusted CEI scores	0.005***	0.006***	0.006***	0.003***	0.004***	0.005***
S6. Exclude non-voluntary CEI scores	0.007***	0.008***	0.008***	0.003***	0.006***	0.005*
S7. Propensity score match on voluntariness	0.005***	0.006***	0.006***	0.003***	0.005***	0.006***
S8. Exclude non-innovating firms	0.006***	0.009***	0.007***	0.004***	0.006***	0.006***
S9. Use log(1 + x) transformation	0.010***	0.015***	0.006**	0.009**	0.010***	0.005***
S10. Include total ESG score as a control variable	0.004***	0.006***	0.005***	0.003***	0.004***	0.003*
S11. Include board diversity as a control variable	0.005***	0.006***	0.006***	0.003***	0.005***	0.005***
S12. Use alternative control variables	0.006***	0.007***	0.006***	0.003***	0.005***	0.005***
S13. Exclude negative CEI scores	0.006***	0.006***	0.007***	0.007***	0.006***	0.005***
S14. Annual change in CEI score	0.139**	0.169**	0.124**	0.086*	0.129**	0.117*
S15. Extended sample period (2003–2024)	0.007***	0.009***				

The table reports the coefficient estimates for *CEI score* from alternative specifications of Eq. (1) with the adjusted measures of innovation intensity and quality used as the dependent variables. *CEI score* is the Corporate Equality Index constructed by the Human Rights Campaign. *Patents* is the adjusted patent count for a given firm and filing year, *Citations* is the adjusted citation count for the firm's patents, *Originality* is the number of NBER technological classes spanned by the cited patent, *Generality* is the adjusted number of technological classes spanned by the citing patents, *Internationality* is the adjusted number of patent assignee countries spanned by the citing patents, and *Inventor count* is the firm's memory adjusted inventor count. The inverse hyperbolic sine transformation is applied to the dependent variables. All variables are winsorized at the 1st and 99th percentiles. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

similar to our main regressions and indicate that LGBTQ-friendly firms are associated with higher innovation intensity and quality.

Our second approach to address voluntary disclosure bias is to use propensity score matching to construct a matched-firm sample in which firms with non-voluntary CEI scores are matched with essentially identical firms that have responded to the surveys. When the regressions are re-estimated using the matched-firm sample (Specification 7 in Table 11), the coefficients for *CEI score* remain positive and highly significant. Taken together, these additional tests suggest that the positive association between LGBTQ friendliness and innovation is not induced by potential biases related to voluntary disclosure.

Sixth, given that most firms in our sample have only a few patents and patent citations in any given year and many firms do not have a single patent granted for multiple years, our empirical findings may be influenced by generic disparities between innovative and non-innovative firms. Therefore, we further examine the sensitivity of our results by re-estimating the regressions using a sample restricted to innovative firms with non-zero patent and patent citation counts. In these regressions (Specification 8), the coefficient estimates for *CEI score* are positive and highly significant. Interestingly, the size of the positive effect of progressive LGBTQ policies on innovation seems to increase when the non-innovative firms are excluded from the sample.

Seventh, in our main analysis, we apply the inverse hyperbolic sine transformation to normalize the highly-skewed zero-bounded dependent variables because of the potential biases related to the conventional logarithmic transformation when the dependent variable contains many zeros (see e.g., Bellemare & Wichman, 2020; Campbell & Mau, 2021; Cohn et al., 2021). Nevertheless, as a robustness check, we re-estimate the regressions with the logarithms of one plus the patent-based innovation measures as the dependent variables. The estimates of these additional regressions (Specification 9) are consistent with our main analysis. Furthermore, as an alternative approach to deal with the large number of zero-valued patent observations, we follow the prior literature (e.g., Bena et al., 2017; Chen et al., 2018; Hirshleifer et al., 2012; Islam & Zein, 2020) and employ Poisson and negative binomial regressions to ascertain that our results are robust to different estimation techniques. Consistent with the OLS estimates reported in Tables 5, 6, and 7, the coefficients for *CEI score* are positive and statistically highly significant throughout the different model specifications regardless of the estimation approach used.[16]

Eighth, we acknowledge that LGBTQ-friendly corporate policies can be considered as one dimension of corporate social responsibility and diversity management. In order to ensure that LGBTQ friendliness has an incremental effect on innovation over the firm's overall engagement in environmental, social, and governance (ESG) dimensions of responsibility, we estimate regressions in which the Thomson Reuters ESG rating is used as an additional control variable.[17] As shown in Table 11, the estimated coefficients for *CEI score* in Specification 10 are positive and remain highly significant in all model specifications after the inclusion of ESG rating as an additional control. This suggests that LGBTQ friendliness is positively associated with innovation intensity and quality regardless of the firm's overall engagement in social responsibility.

In a similar vein, it can be argued that LGBTQ-friendly corporate policies are one dimension of diversity and organizational diversity management policies. To ascertain that LGBTQ friendliness has an incremental impact on corporate innovation over and above the influence of more generic diversity considerations, we next re-estimate the regressions with board gender diversity as an additional control variable (Specification 11).[18] The coefficients for *CEI score* are positive and statistically significant at the 1 % level throughout the alternative regressions. Consistent with Cumming and Leung (2021) and Griffin et al. (2021), the estimates of these additional regressions indicate that board gender diversity is positively associated with innovation.

Tenth, to further examine the robustness of our empirical findings, we estimate additional regressions with alternative definitions of the control variables. Specifically, we measure *Size* as the logarithm of the market value of equity and *Profitability* with the return on equity (ROE), and we replace *Total Q* with the market-to-book ratio and *Capex* with the ratio of property, plant, and equipment to total assets. The estimates of

[16] The results of the Poisson and negative binomial regressions are available upon request.

[17] The Thomson Reuters ESG rating aims to measure the firm's environmental and social responsibility and the strength of corporate governance mechanisms on a scale of 0 to 100.

[18] Recent studies by Cumming and Leung (2021) and Griffin et al. (2021) suggest that board gender diversity is positively associated with corporate innovation.

these additional regressions are consistent with our main analysis, and indicate that LGBTQ friendliness is positively associated with innovation. Throughout the regressions, the coefficient estimates for *CEI score* in Specification 12 are positive and retain their size and statistical significance. Consequently, we can conclude that our results are robust to alternative variable definitions.

Eleventh, the sample used in the analysis includes firms that scored negative points on the CEI due to the general absence of inclusive policies and actions and the presence of blemishes related to LGBTQ discrimination. To ensure that these extreme cases do not bias our results, we re-estimate the regressions after excluding firms with non-positive CEI scores. The coefficient estimates for CEI score in Specification 13 in Table 11 remain positive and statistically significant.

Next, to further strengthen the argument that LGBTQ friendliness enhances corporate innovation, we next investigate whether annual changes in the CEI score are associated with patent quantity and quality. Specifically, we re-estimate the regressions using the annual change in the CEI score as the independent variable, excluding firm-years in which the CEI score remained constant at the maximum value of 100. The estimates of these additional regressions (Specification 14) suggest that improvements in LGBTQ-friendly policies are associated with enhanced corporate innovation, as the estimated coefficients for the change in CEI score are positive and statistically significant across all regression specifications.

Finally, to ensure that the documented positive relationship between LGBTQ friendliness and corporate innovation persists in more recent years, we extend the sample period and collect data on the number of patents and patent citations for the years 2003–2024. We then re-estimate the regressions with *Patents* and *Citations* as the dependent variables using the updated sample. The estimates of these regressions (Specification 15 in Table 11) are consistent with our baseline findings. The coefficient estimates for CEI score remain positive and statistically significant and are very similar in magnitude to those in our main regressions.

Taken as a whole, the additional tests demonstrate that our empirical findings are robust to many different model specifications, econometric estimation techniques, samples and sample restrictions, and variable definitions. Therefore, the results of these tests support the conclusions drawn from our main analysis and provide strong additional evidence to suggest that LGBTQ-friendly employee policies foster corporate innovation.

4. Conclusions

In this paper, we examine the association between LGBTQ-friendly employee policies and corporate innovation. The underlying logic linking LGBTQ friendliness to innovation builds on the human resource management theories regarding employee satisfaction and diversity management. The HRM literature suggests that intangible investments in employee-friendly practices and organizational diversity management policies generate competitive advantages by advancing employee motivation, engagement, and productivity and the firm's ability to recruit and retain the best talent. Loosely parallel with the HRM arguments, the stakeholder theory has been extensively used as a motivation for rationalizing why engagement in social responsiveness and investments in employee satisfaction may pay off by enhancing the firm's relational and reputational capital with its employees and other stakeholders. Given that LGBTQ friendliness is largely conjoined with inclusive and non-discriminatory employee policies, social responsiveness, and embracing diversity in the workplace, the HRM arguments and the stakeholder theory can be used to predict a positive relationship between LGBTQ-friendly employee policies and corporate innovation.

We empirically test the hypothesis that LGBTQ-friendly employee policies foster corporate innovation using data on large publicly traded U.S. firms over the period 2003–2017. In our empirical analysis, we employ the Corporate Equality Index constructed by the Human Rights Campaign to measure firm-level LGBTQ friendliness and we utilize data on patents granted by the U.S. Patent and Trademark Office (USPTO) to build various measures of innovation intensity and quality. Specifically, the intensity of the firm's innovation output is gauged by the number of patents granted and patent citations as well as patent originality, generality, and internationality are used as proxies for innovation quality. In addition, we also use the number of individual inventors as an additional measure of innovation intensity and firm-level concentration of innovative talent.

Consistent with our research hypothesis, we find strong evidence that LGBTQ-friendly firms are associated with higher innovation intensity and quality. Our results demonstrate that firms with progressive LGBTQ policies produce more patents, have more patent citations, and have higher innovation quality as measured by patent originality, generality, and internationality. Furthermore, we document that LGBTQ-friendly firms have a higher concentration of individual inventors as employees. Regardless of the patent-based innovation measure used, the positive effect of LGBTQ friendliness on innovation output is economically meaningful in addition to being statistically significant. Our estimates suggest that a one standard deviation increase in the firm's CEI is associated with an over 20 % increase in the patent count and an almost 25 % increase in the number of patent citations. We utilize instrumental variable regressions and propensity score matching to alleviate endogeneity concerns, and we also conduct a number of additional tests to investigate the robustness of our empirical findings. The additional tests give further support for the hypothesis that LGBTQ-supportive policies have a positive influence on corporate innovation. These tests also suggest that our findings are robust to many different model specifications and variable definitions, alternative econometric estimation techniques, potential self-selection biases as well as many different sample restrictions.

Overall, our results are consistent with the view that diversity considerations and socially progressive corporate policies pay off. While our study provides empirical evidence of the benefits of LGBTQ-friendly policies and practices for corporate innovation, and suggests that these benefits can be attributed to the retention of talented inventors, further research is needed to more precisely identify and establish the mechanisms through which these policies influence a firm's and its employees' propensity to innovate. Our study highlights several possible avenues for future research in this respect, especially regarding the mobility, productivity, and general satisfaction of qualified employees and inventors, both among LGBTQ individuals and the broader workforce, in workplaces that are inclusive to sexual minorities. Additional efforts in this direction should also consider the potential role of corporate governance in ensuring the long-term financial and operational soundness of investments in LGBTQ-friendly practices and the influence of external stakeholders, such as regional attitudes towards progressive social issues, on the effectiveness of these diversity management initiatives.

Declaration of competing interest

None.

Appendix 1

Table 1A
Distribution by year, industry and state.

Year	Avg. patents	No. of obs.	Industry	Avg. patents	No. of obs.	State	Avg. patents	No. of obs.
2003	135.206	184	Agriculture	164.178	28	AR	7.559	59
2004	128.773	190	Mining	28.951	226	AZ	9.196	56
2005	134.884	199	Construction	64.776	922	CA	230.259	583
2006	130.725	197	Manufacturing	215.971	1055	CO	6.000	60
2007	130.914	198	Communication	7.523	869	CT	195.969	97
2008	118.117	221	Wholesale & Retail	12.586	983	DC	44.375	16
2009	111.695	233	Services	136.038	642	DE	253.690	29
2010	82.226	398	Healthcare	2.592	120	FL	10.054	184
2011	93.772	396	Utilities	527.245	53	GA	12.253	170
2012	98.236	415				HI	0.000	3
2013	92.849	431				IA	0.000	6
2014	88.862	445				ID	566.909	11
2015	69.267	467				IL	91.583	367
2016	43.934	472				IN	31.302	53
2017	22.017	452				KS	70.786	42
						KY	31.296	54
						LA	16.069	29
						MA	244.675	126
						MD	91.711	45
						MI	124.677	217
						MN	55.967	153
						MO	76.022	93
						MS	0.000	2
						NC	71.000	116
						ND	0.000	2
						NE	8.048	21
						NH	2.000	1
						NJ	61.434	182
						NM	0.000	12
						NV	1.000	43
						NY	98.720	460
						OH	43.761	226
						OK	0.000	48
						OR	115.194	31
						PA	11.115	227
						RI	24.432	37
						SC	0.750	16
						TN	8.159	107
						TX	44.475	528
						UT	0.556	9
						VA	11.083	168
						WA	245.187	134
						WI	17.960	75

Data availability

Data will be made available on request.

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