Breach of academic values and misconduct: the case of Sci-Hub

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Abstract

This paper investigates the growing evidence of research-related misconduct by developing and testing a theoretical framework. We study the deep causes of misconduct by asking whether the perception of an erosion of the core academic values, formally an ideology-based psychological contract breach, is associated with research-related misconduct. We test our framework by examining the use of Sci-Hub and providing empirical evidence that the loss of faith in scientific research sparkles research-related misconduct against publishers. Based on a stratified sample of 2849 academics working in 30 institutions in 6 European countries, we find that ideology-based psychological contract breach explains Sci-Hub usage, also when controlling for other possible motivations. The magnitude of the effect depends on contextual and demographic characteristics. Females, foreign, and tenured scholars are less likely to download papers illegally when experiencing a contract breach of academic values. Our results suggest that policies restoring academic values might also address research-related misconduct.

> "This business of 'publish-or-perish' has been a catastrophe. People write things which should never have been written and which should never be printed. Nobody's interested. But for them to keep their jobs and get the proper promotion, they've got to do it. It demeans the whole of intellectual life."

> Hannah Arendt 13th July 1972 panel discussion titled "Values in Contemporary Society"

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Introduction

Academic misconduct related to research, such as data fabrication (Fanelli, 2009), citation manipulation (Fong & Wilhite, 2017), plagiarism (Karabag & Berggren, 2012), questionable research practices (Necker, 2014), and misbehaviour in authorship (Smith et al., 2020) is growing (Holtfreter et al., 2020). Research-related scandals in the press,[1] such as the recent case of Prof. Marc Tessier-Lavigne the former President of Stanford University,[2] exacerbate the growing public interest in scholars' research-related misconduct. However, the recent literature on research misconduct is limited to documenting these practices without developing a theoretical framework that might explain why these issues are growing, failing to indicate strategies to prevent and reduce such behaviours.

Nevertheless, not all transgressions are extreme, and some misconducts might be undetected, tolerated, or even encouraged. For instance, while academic software (Rahim et al., 2000; Santillanes & Felder, 2015; Wickham et al., 1992) or article piracy (Duić et al., 2017; Nicholas et al., 2017; Hoy, 2017) might be pretty diffused or socially accepted, still violates copyright and constitutes the break of the law. However, while illegal downloading can be considered a mild research-related transgression, the examination of its determinants is relevant as it might signal a fertile soil for misconduct that might escalate into more severe transgressions (Griep & Vantilborgh, 2018; Spector et al., 2006).

This paper is the first to build a theoretical framework examining the deep causes of research-related misconduct. We define research-related misconduct as a violation of a prescription and a questionable practice while doing research. We exclude any ethical or value considerations attached to it. Beyond breaking copyright law, illegal platforms to download papers harm science in three ways. First, it harms the financial viability of journals that could respond, becoming more expensive and, therefore, even more inaccessible. Furthermore, illegal downloads of scientific literature legally accessible from a library might misrepresent the actual use of subscriptions, determining possible cancellation (McNutt, 2016). Second, academic digital piracy affects the technical infrastructure, exposing ICT infrastructure to risks such as malware attached to the downloaded PDFs or easy the way for hackers to steal researcher's data (Frances et al., 2019). Finally, as reported in the paper, this milder misconduct might lead to more severe transgressions. Relaxing ethical implications, a mild transgression is easier to measure and, according to cognitive psychology, captures causes of misconduct that might generate a slippery slope for more severe transgressions (Welsh et al., 2015).[3] We built a framework specific to the academic profession from an organisational psychology perspective to investigate the deep cause of research-related misconduct in academia. Further, we provide an empirical example of a mild transgression to test it. In particular, we ask whether a psychological contract breach linked to academic values elicits academic misconduct. We test whether the loss of faith in the pillar of research explains one specific research-related misconduct, the illegal access to scientific literature using Sci-Hub. Indeed, the Sci-Hub platform provides access to PDFs of

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[1] See also https://retractionwatch.com for a collection of retraction cases (Last Access July 2023).

[2] See the New York Times article by Stephanie Saul at https://www.nytimes.com/2023/07/19/us/stanford-president-resigns-tessier-lavigne.html (Last Access July 2023).

[3] Existing literature (Griep & Vantilborgh, 2018; Welsh et al., 2015; Spector et al., 2006) on escalating behaviour does not focus on the academic context. Whether or not such escalation might occur also in academia is an empirical question yet to be tackled. However, at the moment, we cannot rule out that the specificities of the academic work (and its values) prevent such spiralling.

academic papers obtained illegally, using stolen individual proxy credentials and violating copyright law. Besides well known contextual (Buehling et al., 2022) or temporary access issues (Herman et al., 2023; Segado-Boj et al., 2022), the platform is illegal but used in high income countries with low access constraints (Duić et al., 2017; Nicholas et al., 2017; Hoy 2017; Till et al., 2019). The latter suggests the existence of a deeper and unconscious motivation.

Along those lines, the literature on organizational psychology indicates that a trigger of misconduct is the experience of a psychological contract breach. Every worker has an implicit and often unconscious psychological contract with their job, a set of beliefs about jobs' rights and duties. When the worker perceives a betrayal of those beliefs, the contract has been breached, and this experience is known to elicit misconduct (Coyle-Shapiro et al., 2019; O'Donohue et al., 2007). Besides the extensive empirical evidence finding that experiencing a psychological contract breach induces misconduct (Coyle-Shapiro et al., 2019), most studies examine the economic or socio-emotional dimensions of psychological contracts, not addressing the characteristics of specific professions. Thompson and Bunderson (2003) highlight that in some professions, the main psychological contract concerns an ideological base. Those ideology-based contracts are a credible commitment of workers to pursue a valued cause that goes beyond self-interest and constitutes the nexus of the individual and his/her profession (O'Donohue et al., 2007). Indeed, many professions have a valued cause intrinsic to them called "ideological currency" (Coyle-Shapiro et al., 2019; Bunderson, 2001). This explains why, a nurse might feel the responsibility of saving lives when off duty (Krause & Moore, 2017) or a researcher might feel the one of advancing the knowledge frontier (O'Donohue et al., 2007). The valued cause of the academic profession is the quest for knowledge and confidence in scientific inquiry. These motivations drive academic values: the interest in fundamental knowledge and in pursuing curiosity-driven research, sharing knowledge, and rewards based on recognition rather than money (Sauermann & Stephan, 2013). These values constitute the backbone of the ideology-based psychological contract of the academic profession (Merton, 1973; Sauermann & Stephan, 2013); as testified by the fact that many researchers are willing to bear the cost of being a scientist, accepting lower salaries (Stern, 2004).

However, academic values are fading under global trends, such as the increase in teaching or administrative load, and in particular, related to research, the pressure on publishing and funding (Siekkinen et al., 2020; Carvalho & Santiago, 2010; Chatelain-Ponroy et al., 2018; Bryson, 2004). These trends have increased academic discontent and might have increased the probability of experiencing an ideology-based psychological contract breach related to academic values that in turn can be associated with research-related misconduct. We argue that the generalised emphasis on results' "publishability" popularised with the expression "publish-or-perish" represents the main potential harm to the fundamental principle of research-related academic values. Today's centrality of the "publish-or-perish" paradigm makes scientific publishers a crucial third party for the academic profession. Indeed, publishers appoint editors, certify the "quality" of scientific research, develop metrics and indicators, and charge expensive subscriptions to scientific publications that can restrict access and harm individuals' careers. Therefore, publishers can be a target for research-related misconduct such as multiple journal submissions, plagiarism, result or data manipulation, and, of course, digital piracy.

In this paper, we develop a testable theoretical framework to explain the growing evidence of research-related misconduct in academia. We identify its origin in the experience of an ideology-based psychological contract breach exacerbated by the publish-or-perish paradigm. We find that an ideology-based psychological contract breach of academic

values predicts academic misconduct toward scientific publishers, namely the illegal download of scientific articles using Sci-Hub. This result is robust across specifications, different operationalization of ideology-based psychological contract breach, and after controlling for common antecedents of digital piracy and trivial explanations for Sci-Hub use (like to save time and for lack of journal access). Our results indicate that scholars experiencing an ideology-based psychological contract breach of academic values are more likely to use Sci-Hub. Additionally, its relative magnitude changes depending on contextual and demographic moderating factors. Specifically, demographic characteristics and job security moderate the link between perceived contract breach and Sci-Hub use. These results imply that any policy to prevent misconduct against publishers must simultaneously address access needs, contextual workplace characteristics, and the consequences of increasing dystonia between publishers' copyrights and academic values.

This paper makes two contributions providing a fresh and original perspective on research-related academic misconduct. First, we contribute to the theory by developing a theoretical framework to explain the growing evidence of research-related academic misconduct combining organisational psychology with the economics of science literature. Relying on both allows a better understanding of the peculiarity of academics and the relevance of specific ideological values (i.e. academic values). Second, our empirical focus has the advantage that mild misconducts, like digital piracy, are perceived armless, and respondents are truthful on their behaviour. In contrast with existing literature on academics' copyright violation and misconduct which focuses on either one scientific discipline (Mejia et al., 2017; Boudry et al., 2019; Karabag & Berggren, 2012; Necker, 2014), one country (Duić et al., 2017; Meyer & McMahon, 2004), or small samples without systematic survey strategies (Nicholas et al., 2017, 2019; Fanelli, 2009), we provide novel and systematic empirical evidence on the diffusion of mild misconduct in academia across disciplines, universities, and countries. We overcome past data limitations using new survey data representative of European scholars. Our sample comprises information on 2849 academics in 30 institutions covering 6 European countries (i.e. Germany, Hungary, Ireland, Italy, The Netherlands, and Sweden).

The paper is structured as follows: section "Theoretical Framework and Research Questions" discusses the theoretical framework and highlights our research questions. Section "Data and methods" describes the data, the variables and the econometric model, section "Empirical results" shows the main results and a robustness test using alternative definitions of ideology-based psychological contract breach. Section "Discussion" discusses the empirical findings and section "Conclusion" concludes.

Theoretical framework and research questions

We combine two separate streams of literature to create a theoretical framework that explains the deep cause of research-related misconduct. First, we use the organisational psychology literature, which examines the role of psychological contract breaches in eliciting misconduct. Second, we leverage the economics of science literature to account for the specificities and ideological dimensions of the implicit contract in academic research. In what follows, we detailed the theoretical framework and applied it to our empirical example of mild misconduct. Our framework is, in principle, testable in other cases of research-related academic misconduct.

Past research examines how the perception of a psychological contract breach negatively affects employees' attitudes and behaviours towards the employing organisation and internal and external parties (Coyle-Shapiro et al., 2019). The literature indicates that the experience of a psychological contract breach negatively affects employees' behaviour reducing performance (Costa & Neves, 2017b), organisational citizenship (Restubog et al., 2010) and increasing misconduct (Bordia et al., 2008), absenteeism (Deery et al., 2006), turnover (Karagonlar et al., 2016) and negative behaviour towards clients or external users (Deng et al., 2018; Conway et al., 2014). While the implicit contract between employer and employees certainly relates to economic and professional aspects, some professions entail an ideological element defined as a credible commitment of workers to pursue a valued cause beyond the self-interest and intrinsic to the profession (Bunderson, 2001; Thompson & Bunderson, 2003; O'Donohue et al., 2007). The literature highlights this possibility; however, only a few studies looked at the consequences of such psychological contract breaches, failing to account for the specific characteristics of each profession (Coyle-Shapiro et al., 2019). A shared adherence to academic values and beliefs characterises the academic profession. Past research has conceptualised these normative values as Mertonian norms (Merton, 1942; Anderson et al., 2010). Mertonian norms include communality (the interest in collaborating and sharing of knowledge), universalism (impersonal evaluation), disinterestedness (no self-motivated interest), and organised scepticism (scrutiny of results based on evidence) (Anderson et al., 2010).

These shared norms are intrinsic to academics and differ from those of other "knowledge workers" (Siekkinen et al., 2020). Examining 5000 US life scientists and physical scientists working either in the industry or in academia, Sauermann and Stephan (2013) show that academics have a different value system compared with corporate scientists testifying the existence of academic values. Academic values are implicit, unspoken values, beliefs, and rules about the academic profession. In contrast to commercial values, individuals endowed with academic values "prefer" the quest for fundamental knowledge and curiosity-driven research upon applied incremental research, research freedom over bureaucratic control, peer recognition over monetary rewards, and open disclosure of research results in the form of publication over patent activity (Sauermann & Stephan, 2013; Agarwal & Ohyama, 2013; Merton, 1973). Unlike other types of work, those who choose an academic career are willing to "pay to be a scientist" as they accept lower wages compared to corporate scientists that might experience publishing restrictions (Stern, 2004; Sauermann & Roach, 2014; Stern, 2004).[4] The diffusion of such values and the willingness to earn less to adhere to them indicates that the implicit contract characterising the academic job has a strong ideological dimension.

In the case of academics, beliefs concerning their job relate to terms and conditions (such as duties and rights, job security, career development, and work-life balance) and loyalty to academic value. Any systematic dyscrasia between academics' experience and expectations about both dimensions breaches the contract between an academic and its institution. Increasing performance-based managerialism, bureaucratisation, and university market-like behaviour (Siekkinen et al., 2020; Chatelain-Ponroy et al., 2018; Walsh & Lee, 2015), as well as changes in sizes and the shift to short-term contracts (Bryson, 2004; Hakala, 2009; Cyranoski et al., 2011), have enormously changed the academic work. Whether these changes are good or bad, they might have altered the inner perception of

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[4] Based on a sample of 164 multiple job offers received by 66 Ph.D.s in Biology, Stern (2004) estimates that scientists accept a wage 14,000$ lower to have the freedom to publish their results.

academics regarding their job and the profession's core values, producing more significant responses than general psychological contract breaches (Bunderson, 2001).

A significant change in the academic profession is the diffusion of the "publish-or-perish" paradigm.[5] This principle makes scholars more concerned about the publishability of their results, affecting topic choices and reducing scholars' freedom in pursuing curiosity-driven research. This reduced freedom undermines one of scientific research's fundamental principles, harming academic values. A secondary but not less important consequence of the emergence of the "publish-or-perish" culture is the identification of scientific publishers as a relevant third party, contributing to jeopardising academic values. While scientific publishers restrict access to science and exploit academic free work (i.e. editors and referees often work for free), they indirectly influence scholars' choice of publishing outlets. Better-ranked journals can attract scholars' attention, and scholars might adapt their research priorities to fit the journals that are better ranked. Such mechanisms have been observed in relation to funding schemes (Laudel, 2006), but reasonably, to maximise publishability, scholars might adapt to journals' issues and topics. Along these lines, publishers certify research quality and journal metrics might influence scholars' topic choices.

Thus, the experience of a contract breach derived from undermining academic values related to the emergence of the "publish-or-perish" paradigm triggers a reaction towards scientific publishers. Therefore, our main research question is:

RQ1 Are academics experiencing an ideology-based psychological contract breach related to a deterioration of academic values more likely to violate Copyright using Sci-Hub?

Moderating factors

While we expect that perceiving an ideology-based psychological contract breach relates positively to misconduct against publishers, some employees' characteristics might moderate the relation.

A large body of literature highlights gender discrimination in academia. Female scholars are underrepresented across fields and job ranks (Kahn & Ginther, 2017; Rossello, 2021), less likely to be promoted (De Paola & Scoppa, 2015), are paid less (Barbezat & Hughes, 2005) and obtain lower recognition from co-authorship (Sarsons, 2017). The presence of gender stereotypes and discrimination affects women's careers and often makes academia a male-dominated environment. However, the women who make it through might have developed strategies to cope with such an environment. Recent theoretical work explores the link between female discrimination and resilience (Bridges et al., 2021). It highlights that females with high individual resilience are more likely to thrive in a male-dominated environment. Thus, females pursuing an academic career might be used to negative experiences in the workplace and resilient in response to ideology-based psychological contract breaches.

This widespread resignation to the current "status quo" could make women decouple their career expectations from their publication performance. While aware of likely "perish", women are more indifferent to the "publish-or-perish" paradigm. This observation

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[5] In some disciplines and universities the "publish or perish" paradigm, has been supplanted by the emerging "have an impact or perish" paradigm. The latter emphasises scientometrics indicators such as IF, citations, and more broadly the societal interest.

is supported by the empirical evidence that women publish fewer articles than male colleagues (Rossello et al., 2023) and are generally less interested in competition (Dato & Nieken, 2014). Furthermore, a recent meta-analysis confirms that, in general, females are less likely to engage in misconduct (Ng et al., 2016) and less involved in misconducts such as workplace aggression (Hershcovis et al., 2007), sabotage (Dato & Nieken, 2014), and digital piracy (Mejia et al., 2017; Duić et al., 2017).

Thus, our second research question is:

RQ2 Are female academics less likely than males to respond with copyright violations through Sci-Hub when experiencing an ideology-based psychological contract breach related to a deterioration of academic values?

Foreign workers are part of a minority in the workplace and, similarly to females, experience discrimination (Aguirre, 2020; Dupree & Boykin, 2021). The theoretical link between discrimination and resilience applies to workers from a minority too (Bridges et al., 2021). Thus, foreign workers who continue their careers at universities might have developed high individual resilience to thrive in a context dominated by white males. Additionally, they might be less susceptible to the "publish-or-perish" paradigm. Recent empirical research found, for example, that scholars from an underrepresented minority are interested in topics systematically less likely to be funded (Hoppe et al., 2019) or published (Zeina et al., 2020). Experiences of discrimination can make foreign scholars more resilient to academic discontent, moderating the link between ideology-based psychological contract breaches and misconduct. Thus, we ask:

RQ3 Are foreign academics less likely than domestic to respond with copyright violations through Sci-Hub when experiencing an ideology-based psychological contract breach related to a deterioration of academic values?

Besides gender and nationality, some context-specific features, such as job insecurity, play a role in strengthening the relationship between psychological contract breach and misconduct (Piccoli & De Witte, 2015; Costa & Neves, 2017a; Coyle-Shapiro et al., 2019). Employees' job insecurity generates the perception of a lack of reciprocity because the organization signals to its employees that it does not value their contribution (Piccoli & De Witte, 2015). In academia, non-tenured faculty are under pressure to publish to progress their career. Based on a sample of 448 tenured and non-tenured faculty members in management departments in the US, Miller et al. (2011) find that tenured faculty feel less pressure for publishing than non-tenured ones. Overall, non-tenured academics are strongly affected by the diffusion of the "publish-or-perish" culture that jeopardises academic values.

Accordingly, we ask:

RQ4 Are faculty members less likely than non-tenured to respond with copyright violations through Sci-Hub when experiencing an ideology-based psychological contract breach related to a deterioration of academic values?

Data and methods

In this section, we describe the survey, how we stratify the sample, how we operationalised the measure of ideology-based psychological contract breach, and the econometric model.

Survey method

We answer our research questions using an original database collected through an online survey targeting 30 European universities. We stratified the sample selecting the top five universities from the 2021 Times Higher Education World University Ranking in Germany, Hungary, Ireland, Italy, Netherlands, and Sweden.[6] We select these countries to account for different types of European university systems (Center-European, Southern-European, Northern-European, Eastern-European, and Anglo-Saxon) and to ensure representativeness across Europe.[7]

Our research design and questionnaire received the ethical approval from the Research Ethics Committee of the Scuola Superiore Sant'Anna before the commencement of the study on the 11th of February 2021. We directly distributed the survey between June and October 2021 through university email addresses we web-scraped from each institution's website. We collected approximately 104,000 email addresses, scraping information from more than 19,700 web pages of the 30 target universities. We should remark, though, that while we tried to target all the academics with any research or teaching activities and job contracts in the select universities, in some cases, we could not identify and exclude the administrative personnel. We had a filter-out option at the beginning of the survey, so our final sample includes only academic staff. Indeed, very few non-academics entered the survey in the first place since the invitation letter explicitly targeted academics. This collection strategy allows us to cover all academic fields (including humanities) and all types of contracts (part-time, contract professors, teaching contracts).

Considering that we sent the survey to the complete population working at those 30 target universities, our sample of 2849 responses represents our target population well. Indeed, the representative sample size of a population of 104,020 people with a selected margin of error of 3% and a confidence level of 99% is 1811; way below our sample size.[8]

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[6] See table 6 in the Appendix for the list of universities in each country. We decided to exclude from our sample medical schools because too small and our institutions to avoid biases in responses. Furthermore, we withdrew Wageningen University & research as the university denied permission to distribute our survey to the faculty directly. Their proposed delivery method was not scientifically sound for this research purpose.

[7] The selected countries represent the different universities systems: Center-European (Germany), Souther-European (Italy), Northern-European (Netherlands, Sweden), Eastern-European (Hungary), and Anglo-Saxon (Ireland). Germany is the most populous European country and represents Center-European university systems. Italy has the oldest university in the world (the University of Bologna funded in 1088), is the 3rd most populous European country and represents Southern-European university systems. Germany and Italy are among the largest university systems in Europe (https://www.statista.com/statistics/918403/number-of-universities-worldwide-by-country/). The Irish university system has similarities with the UK and a hybrid public-private system. The Netherlands and Sweden represent Northern-European countries with a relatively small population but primarily focus on technology and research. Hungary represents Eastern European university systems and has a long historical tradition in research. It is the 25th country in the world for relative research spending.

[8] https://www.checkmarket.com/sample-size-calculator/; last access November 2021.

Table 7 in the appendix explores the representatives of our sample compared with the European University System. We show that our sample gives a good representation of the different types of European Systems across geographical areas. Additional details on representativeness and the questionnaire are available in the report for the European Commission that preceded this study (Rossello et al., 2022).[9] The data that support this study's findings are available from the corresponding author upon request.

In our sample 40% of respondents are females, 20% are foreigners,[10] 60% are faculty members, and the average age is 45 years. Looking at respondents by country, 16% are from Germany; 6% from Hungary; 10% from Ireland; 33% from Italy; 15% from The Netherlands; and 19% from Sweden. The distribution of respondents by field is 18% Life Sciences (LS); 29% Physical Sciences & Engineering (PE); 42% Social Sciences & Humanities (SH); the remaining 11% conduct cross-domain research.[11][12]

Measuring ideology-based psychological contract breach

In this section, we describe how we operationalised the variable ideology-based psychological contract breach. Moreover, since we are aware that defining these concept is not easy and might be controversial, in section "Robustness checks: alternative measures of ideology-based psychological contract breach" we provide several robustness checks of our results using alternative measures of ideology-based psychological contract breach related to academic values.

Most of the literature in organizational psychology measures psychological contract breaches using Likert scales or dichotomous variables derived from survey data (Coyle-Shapiro et al., 2019; Robinson & Brown, 2004). In the first case, a sentence related to contract fulfilment or breach is included in the survey and respondents indicate to what extent they agree or disagree with it. The advantage of this approach is developing a standardised measure that considers breach as a nuanced process and not a discrete event. However, this method has the drawback that respondents arbitrarily perceived alternatives as similar and picked one over the other. This is particularly problematic when, as in our case, similar concepts are presented. Since we aim to discriminate between different types of psychological contract breach and to isolate the ideology-based one, Likert scales over those types are inappropriate since respondents might have difficulty discriminating between similar concepts, leading to measurement errors (Robinson & Brown, 2004). To avoid this issue we use dichotomous variables. Subsequently, we account for the potential limitations of dichotomous variables and our definition providing results (see section "Robustness checks: alternative measures of ideology-based psychological contract breach") using alternative measures of ideology-based psychological contract breach.

In our survey, we asked, *"What are for you the most negative aspects of being an academic"* where respondents could select one or more items from the following 13, representing different types of psychological contract breaches:

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[9] The report is available at https://zenodo.org/records/6793215#.YsKLg3ZBw2w last access February 2024.

[10] Among the scholars with a foreign nationality the 31% come from a developing or emerging economy.

[11] They report more than one broad ERC field (PE, SH, and LS).

[12] The list of ERC fields is available at https://ejoss.euras-edu.org/erc-field-classification/; last access February 2024.

1. *teaching responsibilities* (*TEACHING_LOAD*);
2. *administrative responsibilities* (*ADMINISTRATIVE_LOAD*);
3. *not being prepared, emotionally for distressing aspects of competition* (*COMPETI-TION_LOAD*);
4. *being unable to concentrate on my research* (*LACK_RESEARCH_TIME*);
5. *feeling under pressure to proceed in the career* (*CAREER_STRESS*);
6. *the behaviour of junior colleagues* (*BEHAVIOUR_JUNIOR_COLLEAGUES*);
7. *the behaviour of senior colleagues* (*BEHAVIOUR_SENIOR_COLLEAGUES*);
8. *the inadequate facilities or funding* (*LACK_FUNDING_FACILITIES*);
9. *being away from home* (*HOMESICKNESS*);
10. *the feeling that sometimes my research is a waste of time* (*RESEARCH_WASTE_TIME*);
11. *the feeling that sometimes my research is a waste of public money* (*RESEARCH_WASTE_MONEY*);
12. *it undermined my confidence in knowledge and science* (*IDEOLOGY_BASED_BREACH*);
13. *not having the appropriate recognition from my colleagues* (*LACK_RECOGNITION*).

Starting from the idea that the pillar of academic research is confidence in the scientific method. We consider item 12 *"It undermined my confidence in knowledge and science"* an indicator of a violation of academic values and, therefore, a measure of ideology-based contract breach. Thus, we operationalise ideology-based psychological contract breach building the dummy *IDEOLOGY_BASED_BREACH* equal to one if the respondent selected item 12 and zero otherwise. Our ideology-based contract breach variable accounts for different perceptions of violations of academic values. Our variable of ideology-based contract breach accounts for different types of perceptions of violation of academic values. For instance, label 12 measures an ideology-based contract breach that stems from local (personal, agent's neighbourhood) and global practices generalised in academia. Indeed, Anderson et al. (2010) recognised the latter's importance. They found that researchers generally perceive their conduct as aligned with the scientific norms and values and view their peers as not adhering to them. We believe that a generalised sense that others behave in contrast to academic values creates an even more accentuated sense of frustration where a simple breach of the psychological contract becomes a perception of a generalised violation of thereof.

10% of our respondents (271) selected item 12. Examining the correlation with other characteristics, we found that ideology-based breach is not correlated with being foreign (cor. coef.=0.011 p-value= 0.561) and has weak correlations with gender (cor. coeff.= 0.057, p-value= 0.002) and being a faculty member (cor. coef.= −0.140 p-value= 0).

In section "Robustness checks: alternative measures of ideology-based psychological contract breach", we checked the robustness of our results at alternative measures of ideology-based psychological contract breach.

Econometric model and other variables

Our dependent variable represents Sci-Hub users. Is a dummy equal to one if the respondent used Sci-Hub in the past and zero otherwise. We address the dichotomous nature of our

dependent variable running logistic regressions. Thus, we consider the following model to answer our research question:

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\begin{aligned}
Pr(\text{USE\_SCI\_HUB}_i = 1) \\
= \Lambda(\beta_0 + \beta_1 \text{IDEOLOGY\_BASED\_BREACH}_i \\
+ \beta_2 \text{MODERATORS}_i + \beta_3 X_i + \theta_f + \theta_u + \theta_c)
\end{aligned} \tag{1}
$$

where *IDEOLOGY_BASED_BREACH* is our measure of ideology-based psychological contract breach presented in the previous section. *MODERATORS* are the dummies *FEMALE* equal to one for females and zero otherwise, *FOREIGN* equal to one if respondents indicate a foreign nationality and zero otherwise, and *FACULTY* equal to one if faculty member and zero otherwise. X is the vector of control variables, and θ_f, θ_u, and θ_c are dummy variables controlling for respondents' ERC scientific field, university, and country.

To answer our research questions about factors moderating the main relation between *IDEOLOGY_BASED_BREACH* and using Sci-Hub, we add interaction terms in the model as follows.

$$
\begin{aligned}
Pr(USE\_SCI\_HUB_i = 1) \\
= \Lambda(\beta_0 + \beta_1 IDEOLOGY\_BASED\_BREACH_i + \\
+ \beta_2 MODERATORS_i + \beta_3 X_i + \\
+ \beta_4 \text{IDEOLOGY\_BASED\_BREACH}_i \times \text{MODERATOR}_i \\
+ \theta_f + \theta_u + \theta_c)
\end{aligned} \tag{2}
$$

We interact *IDEOLOGY_BASED_BREACH* with one dummy variable described in the theoretical framework as moderator *FEMALE* or *FOREIGN* or *FACULTY*.

The vector *X* includes controls for several factors identified in the literature as drivers of digital piracy. In a recent meta-analysis, Eisend (2019) examines 174 studies conducted in 36 countries between 1980 and 2016 and underlines four groups of theories to explain digital piracy that we use as a theoretical framework to identify our main control variables: i) reasoned action and planned behaviour, ii) ethical decision-making models, iii) expected utility theory, and iv) reinforcement mechanisms.

Both reasoned action and planned behaviour concern the cultural dimension of the individual. The first considers the behaviour as driven by social norms and, therefore, whether the social locus of the agent accepts the use of piracy. We control for this with the variable *COLLEAGUES_PIRACY_PERCEPTION*, which ranges from 1 *"Extremely uncommon"* to 8 *"Extremely common"* and encode responses to the question *"Software piracy is considered common or uncommon among your colleagues"*. The second theory suggests the importance of perceived control ability over the act of pirating (i.e. how easy or difficult it is for agents to do piracy, avoiding negative consequences). Since this might be a sensitive question, we control for this factor, asking about the training respondents receive about copyright law and enforcement. The variable *INSTITUTIONAL_TRAINING* ranges from 1 *"No"* to 4 *"Yes"*. The associated question is *"Does your university institution provide guidance and advice of rules relating to copyright law and your work as an academic?"*. This variable captures how training in the topic might better inform about the illegal nature of breaking copyright law, possibly deterring this behaviour. *COPYRIGHT_KNOWLEDGE* captures a similar mechanism where knowledge about copyright norms might affect the likelihood of using illegal access despite knowing about possible legal consequences. This variable ranges from 0 (none of the symbols known) to 6 (all symbols known) depending on

Table 1 Summary Statistics of regression variables

Variable Name	N	Mean	St. Dev.	Min	Max
Dependent variable:					
USE_SCI-HUB	2,849	0.5	0.5	0	1
Contract breach:					
IDEOLOGY_BASED_BREACH	2,849	0.1	0.3	0	1
ACADEMIC_BREACH	2,849	1.7	1.1	0	6
RESEARCH_BREACH (PC1)	2,849	1.3e−09	1.4	−1.9	6.3
COLLEAGUES_BEHAVIOUR (PC2)	2,849	1.2e−09	1.2	−2.1	6.6
SENIOR_DISCONTENT (PC3)	2,849	-1.2e−09	1.1	−4.0	4.5
Moderators:					
FEMALE	2,849	0.4	0.5	0	1
FOREIGN	2,849	0.2	0.4	0	1
FACULTY	2,849	0.6	0.5	0	1
Controls:					
		Ethical Decision-Making Models			
MORAL_JUSTIFICATION	2,822	2.9	1.2	1	4
UNETHICAL_PUBLISHERS	2,849	0.6	0.5	0	1
		Reasoned Action - Norms			
COLLEAGUES_PIRACY_PERCEPTION	2,827	4.1	2.1	1	8
		Planned Behaviour - Control Ability			
INSTITUTIONAL_TRAINING	2,844	3	1.1	1	4
		Expected Utility Theory			
LIBRARY_SATISFACTION	2,847	6.5	1.6	1	8
TEACHING_LOAD	2,849	0.1	0.3	0	1
COPYRIGHT_KNOWLEDGE	2,763	2.0	2.1	0	6
		Reinforcement mechanisms			
PAST_PIRACY	2,841	5.6	2.5	1	8

how many of the shown six most common copyright Creative Commons symbols respondents declare to know. Both variables consider the potential for avoiding negative outcomes while using Sci-Hub, since individuals who know copyright law can predict consequences.

According to ethical decision-making models, another important driver of digital piracy is the trade-off between the morality of the individual and her/his justification for breaking the law (Jacobs et al., 2012; Nicholas et al., 2019). We control for this factor using the variable *MORAL_JUSTIFICATION,* which ranges from 1 *"Yes"* to 4 *"No"* where respondents answer the question *"Do you feel guilty when you use copyrighted material (papers, software, books, movies) without permission for research purposes?"*. Finally, in the case of using Sci-Hub, the academics' perception of scientific publishers might play a role in the individual moral justification as they might consider using Sci-Hub as a boycott act. We control for this factor through the dummy variable *UNETHICAL_PUBLISHERS*. This dummy is equal to one if the respondent reported above the median score to the question: *"How much adequate from 0 to 100 is the sentence to describe your thoughts: Big publishers (like Springer-Nature or Elsevier) have an unethical business model and their profits rely on the free work of academics"*.

Table 2 Summary Statistics of the Usage of Sci-Hub

| | Total | | USE_SCI-HUB | | | |
| | Resp. | | No | | Yes | |
	N	Col.%	N	Row %	N	Row %
Country						
GERMANY	460	16%	234	51%	226	49%
HUNGARY	173	6%	60	35%	113	65%
IRELAND	292	10%	174	60%	118	40%
ITALY	951	33%	452	48%	499	52%
NETHERLANDS	421	15%	203	48%	218	52%
SWEDEN	552	19%	378	68%	174	32%
ERC fields						
LS	509	18%	268	53%	241	47%
PE	813	29%	371	46%	442	54%
SH	1188	42%	686	58%	502	42%
PE.LS	88	3%	48	55%	40	45%
PE.SH	126	4%	51	40%	75	60%
PE.SH.LS	22	1%	9	41%	13	59%
SH.LS	78	3%	48	62%	30	38%
Total	2849	100%	1501	53%	1348	47%

Notes: The 25 ERC academic fields are aggregated here in the 3 broad categories PE (1–10) is Physical Sciences & Engineering; SH (1–6) is Social Sciences & Humanities; LS (1–9) is Life Sciences. Individual were asked to select up to 4 ERC sub-categories

The expected utility theory predicts as drivers of digital piracy the positive or negative outcomes of piracy (Peace et al., 2003). Positive outcomes, in this case, are the obvious reasons why people might use Sci-Hub, the lack of access to the scientific literature (Boudry et al., 2019), and/or because it is convenient and saves time (Travis, 2016; González-Solar & Fernández-Marcial, 2019). While we have this information for Sci-Hub users, we do not have it for non-users. We overcome this issue by proxying the lack of access to the literature and Sci-Hub convenience using the variable *LIBRARY_SATISFACTION*. This variable ranges from one *"Extremely Dissatisfied"* to 8 *"Extremely Satisfied"* to the question *"How much you are satisfied or dissatisfied with the resources of your library"*. In addition, we add *TEACHING_LOAD,* a dummy equal to one if the respondent reports an excessive teaching load and zero otherwise, as a lack of time is often associated with finding shortcuts to save time while doing research.

At last, frontier research in digital piracy shows the reinforcement role of agents' pirating experience in predicting future pirate behaviour (Cronan & Al-Rafee, 2008; Eisend, 2019). We control users' piracy experience using the variable *PAST_PIRACY*. This variable ranges from 1 *"Extremely unlikely"* to 8 *"Extremely likely"* depending on the respondent's answers to the question *"When you were a student, how likely or unlikely is that you used proprietary software, data, or books copies without the licence"*. Table 1 reports the descriptive statistics of all the variables included in the regressions.

Table 3 Main specification and models with moderating effects

	Dependent variable: USE_SCI-HUB					
	(1)	(2)	(3)	(4)	(5)	(6)
FACULTY	−0.835***		−0.802***	−0.802***	−0.808***	−0.753***
	(0.0959)		(0.0965)	(0.0965)	(0.0967)	(0.100)
FEMALE	−0.147		−0.165*	−0.159	−0.167*	−0.163*
	(0.0960)		(0.0965)	(0.102)	(0.0966)	(0.0966)
FOREIGN	0.345***		0.347***	0.346***	0.407***	0.343***
	(0.122)		(0.123)	(0.123)	(0.128)	(0.123)
COPYRIGHT_KNOWLEDGE	0.141***		0.141***	0.141***	0.142***	0.142***
	(0.0215)		(0.0215)	(0.0216)	(0.0216)	(0.0215)
MORAL_JUSTIFICATION	0.369***		0.365***	0.365***	0.366***	0.367***
	(0.0384)		(0.0384)	(0.0384)	(0.0385)	(0.0385)
LIBRARY_SATISFACTION	−0.0821***		−0.0817***	−0.0816***	−0.0811***	−0.0825***
	(0.0292)		(0.0291)	(0.0291)	(0.0292)	(0.0292)
PAST_PIRACY	0.121***		0.121***	0.121***	0.121***	0.122***
	(0.0201)		(0.0201)	(0.0201)	(0.0200)	(0.0201)
COLLEAGUES_PIRACY_PERCEPTION	0.148***		0.148***	0.148***	0.148***	0.149***
	(0.0236)		(0.0238)	(0.0238)	(0.0238)	(0.0238)
TEACHING_LOAD	0.342**		0.351**	0.350**	0.348**	0.346**
	(0.159)		(0.160)	(0.160)	(0.160)	(0.160)
INSTITUTIONAL_TRAINING	0.0414		0.0406	0.0405	0.0395	0.0399
	(0.0414)		(0.0415)	(0.0415)	(0.0415)	(0.0415)
UNETHICAL_PUBLISHERS	0.301***		0.292***	0.292***	0.294***	0.289***
	(0.0925)		(0.0927)	(0.0927)	(0.0927)	(0.0927)
IDEOLOGY_BASED_BREACH=1		0.746***	0.560***	0.591***	0.682***	0.792***
		(0.133)	(0.150)	(0.212)	(0.167)	(0.201)

Table 3 (continued)

	Dependent variable:					
	USE_SCI-HUB					
	(1)	(2)	(3)	(4)	(5)	(6)
IDEOLOGY_BASED_BREACH=1 X FEMALE=1				−0.0652		
				(0.300)		
IDEOLOGY_BASED_BREACH=1 X FOREIGN=1					−0.660*	
					(0.358)	
IDEOLOGY_BASED_BREACH=1 X FACULTY=1						−0.591*
						(0.313)
COUNTRY	Yes	No	Yes	Yes	Yes	Yes
ERC	Yes	No	Yes	Yes	Yes	Yes
UNIVERSITY	Yes	No	Yes	Yes	Yes	Yes
OBSERVATIONS	2701	2849	2701	2701	2701	2701

Notes: The dependent variable is a dummy equal to 1 if the respondent used Sci-Hub in the past and 0 otherwise. Models are estimated using a logit model and the coefficients are reported. Robust standard errors in parentheses
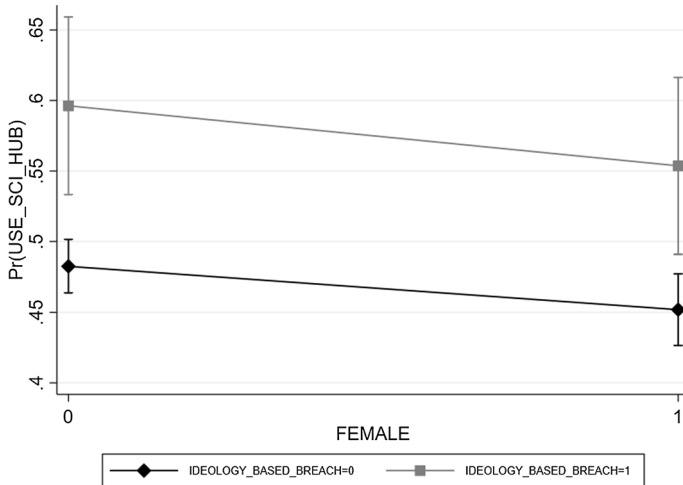
Legend: *$p<0.1$; **$p<0.05$; ***$p<0.01$

Fig. 1 Marginal effects *IDEOLOGY_BASED_BREACH*. Model in column 4 table 3 testing hypothesis RQ2. The x-axis shows *FEMALE=1* and *MALE=0* while the y-axis is the predicted probability of Using Sci-Hub

Empirical results

In this section, we present some descriptive patterns and the results of the econometric exercise.

Table 2 shows how the use of Sci-Hub distributes across countries and academic fields. Overall, 47% of the academics used Sci-Hub, and not surprisingly, this varies more across countries than across academic fields. Looking across countries, academics using Sci-Hub varies from 65% in Hungary to 32% in Sweden. In contrast, across fields, it varies between 60% in the interdisciplinary field of Physical Sciences & Engineering and Social Sciences & Humanities (PE.SH) to 38% in the interdisciplinary field of Social Sciences & Humanities and Life Sciences (SH.LS). Regarding the intensity of Sci-Hub use, Fig. 4 in the appendix shows that most are frequent users. Among users, 45% used Sci-Hub more than 10 times in a year. For this reason, we dichotomised our dependent variable and focused the analysis on Sci-Hub usage rather than the intensity of use. In Table 9 in the appendix, we run several robustness checks considering usage intensity as the dependent variable. Results obtained using Poisson and ordered logistic models are similar in magnitude and significance.

Table 3 reports the estimation results of equations 1 and 2. Column 1 shows regression results including only the controls and the moderators, whereas column 2 includes only our main variable *IDEOLOGY_BASED_BREACH*. In column 3, we report the results for estimating equation 1 to answer the first research question.

The model in column 3 indicates that the experience of an ideology-based contract breach *(IDEOLOGY_BASED_BREACH=1)* corresponds to a statistically significant increase in the likelihood of using Sci-Hub. Considering the odds ratios, the estimated model indicates a sizable effect. All else being equal, those who experienced an ideology-based contract breach have 75% more odds of using Sci-Hub compared to those who do not experience it *(IDEOLOGY_BASED_BREACH=0)*. This finding answers our main research question (**RQ1**) and confirms the positive correlation between ideology-based breaches and misconduct related to digital piracy. Academics who experience an
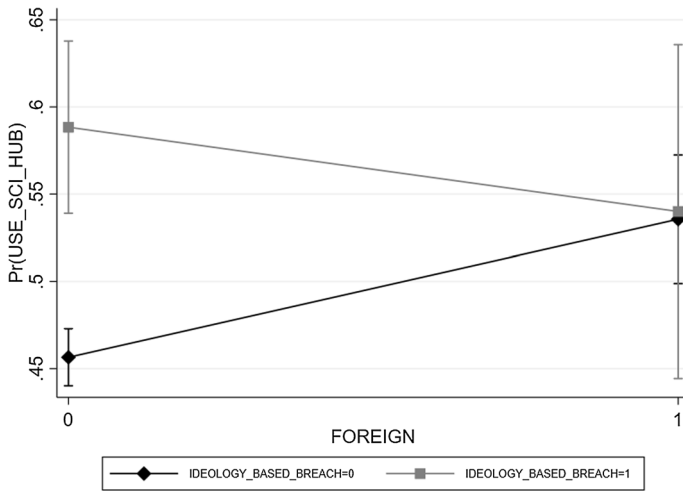
Fig. 2 Marginal effects *IDEOLOGY_BASED_BREACH*. Model in column 5 table 3 testing RQ3. The x-axis shows *FOREIGN=1* and *NON-FOREIGN=0* while the y-axis is the predicted probability of Using Sci-Hub

ideology-based psychological contract breach related to a deterioration of academic values are more likely to violate publishers' copyright using Sci-Hub.

Looking at the controls and the moderators, models 1–2 report results consistent with the existing literature. The likelihood of using Sci-Hub is lower for females (*FEMALE*) and faculty members (*FACULTY*), whereas it is higher for foreign scholars (*FOREIGN*).

The likelihood of using Sci-Hub decreases the higher the perceived quality of the genuine product, expressed by the satisfaction individuals report about the library service of their institution (*LIBRARY_SATISFACTION*). Several controls have the expected positive sign and drive Sci-Hub use. These are individual moral justification for breaking copyright law (*MORAL_JUSTIFICATION*), scientific publishers' business model perception as unethical (*UNETHICAL_PUBLISHERS*), excessive teaching load (*TEACHING_LOAD*), and positive social perception surrounding piracy (*COLLEAGUES_PIRACY_PERCEPTION*). Moreover, the likelihood of using Sci-Hub is higher for experienced users (*PAST_PIRACY*), and knowledgeable scholars about copyright (*COPYRIGHT_KNOWLEDGE*).

Results in columns 4–6 of table 3 answer the research questions related to moderating effects of workers' characteristics. Since we are estimating a nonlinear model, the interpretation of the interaction effects cannot be based only on the signs and significance of the coefficients (Ai & Norton, 2003). Thus, we plot the marginal effects.

RQ2 asks whether females experiencing an ideology-based psychological contract breach are less likely to use Sci-Hub. Column 4 in table 3 and the marginal effects of the predicted probability in Fig. 1 indicate that we cannot answer affirmatively. Overall, we can observe that the interaction term of *FEMALE* and *IDEOLOGY_BASED_BREACH* is negative but not different from zero at 10% significance level. Figure 1 shows that the probability of using Sci-Hub is higher for both males and females experiencing *IDEOLOGY_BASED_BREACH,* and males appear more responsive to *IDEOLOGY_BASED_BREACH* than females.

Column 5 in table 3 answers about the moderating role of being foreign (**RQ3**). The result supports our claim that foreign academics are less likely than domestic to respond
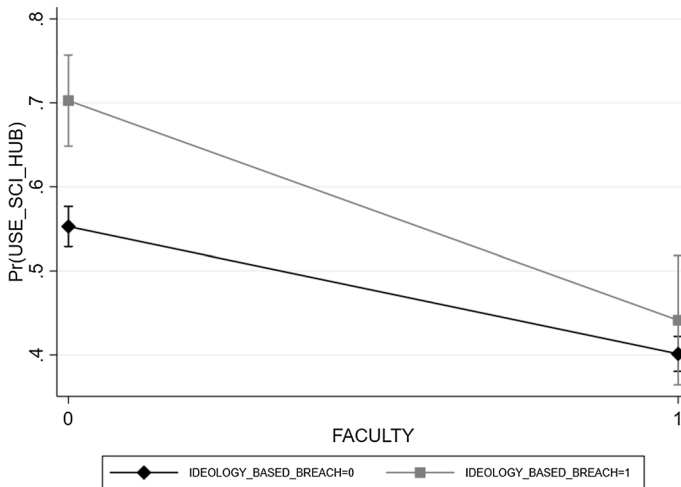
Fig. 3 Marginal effects *IDEOLOGY_BASED_BREACH*. Model in column 6 of table 3 test RQ4. The x-axis shows *FACULTY=1* and *NON-FACULTY=0* while the y-axis is the predicted probability of Using Sci-Hub

with copyright violations through Sci-Hub when experiencing an ideology-based psychological contract breach related to a deterioration of academic values. The interaction term of *IDEOLOGY_BASED_BREACH* and *FOREIGN* is negative and significant at 10% significance level. Looking at the marginal effects in Fig. 2, we can observe that academics' probability of usingSci-Hub is higher for those experiencing *IDEOLOGY_BASED_ BREACH*. At the same time, foreigners are equally likely to use Sci-Hub irrespective of their experience of *IDEOLOGY_BASED_BREACH*. In other words, domestic academics are more responsive to *IDEOLOGY_BASED_BREACH* than foreigners.

Finally, the model in column 6 of table 3 addresses **RQ4**, where we ask about the moderating effect of having a more stable job condition (i.e. being tenured and being a faculty member). The coefficient of the interaction term is negative and significant at 10% significance level. The marginal effects in Fig. 3 provide additional details and help interpret the effect. The probability of using Sci-Hub is higher for non-faculty members experiencing an ideology-based psychological contract breach. However, there is no difference in the probability of Sci-Hub usage for faculty members. We can conclude that non-faculty members are more responsive to an ideology-based psychological contract breach than faculty members.

One potential concern is that those who did not use Sci-Hub are unaware of it. In Table 8 in the appendix, we add a variable that proxies it to our main models. The variable asked whether the respondent discussed Sci-Hub with colleagues (No, Maybe, Yes), and we think those who discussed it know about it. However, we should remark that this proxy has some caveats since those who did not discuss it with colleagues might still know it. Besides this concern, our results are robust to the inclusion of the variable.

Robustness checks: alternative measures of ideology-based psychological contract breach

Capturing the perceived contract breach is not straightforward. The literature has proposed several alternative approaches (see section "Measuring ideology-based psychological

Table 4 Results of PCA on the 13 variables representing the negative aspects of being an academic described in section "Measuring ideology-based psychological contract breach"

Variable	PC1 Research Breach	PC2 Colleagues Behaviour	PC3 Senior Discontent	PC4 Lack of Time
TEACHING_LOAD	−0.0738	0.2008	0.0771	0.4475
ADMINISTRATIVE_LOAD	−0.3253	0.1915	0.1833	0.3655
COMPETITION_LOAD	0.3943	−0.0041	−0.3180	0.2102
LACK_RESEARCH_TIME	0.0654	0.2182	0.1853	0.6056
CAREER_STRESS	0.3974	−0.1324	−0.3459	0.1511
BEHAVIOUR_JUNIOR_COLLEAGUES	0.0815	0.4816	0.1567	−0.2452
BEHAVIOUR_SENIOR_COLLEAGUES	0.1847	0.5556	−0.0257	−0.1489
LACK_FUNDING_FACILITIES	−0.0528	0.3263	−0.2386	0.1428
HOMESICKNESS	0.2303	−0.0501	−0.4243	0.1855
RESEARCH_WASTE_TIME	0.4745	−0.0676	0.3620	0.0108
RESEARCH_WASTE_MONEY	0.3667	−0.1098	0.4738	−0.0626
IDEOLOGY_BASED_BREACH	0.3153	0.0713	0.2264	0.1097
LACK_RECOGNITION	0.1246	0.4320	−0.1907	−0.2815
Eigenvalues	1.90	1.31	1.21	1.13
Proportion of variance	0.15	0.10	0.09	0.09
Cumulative prop	0.15	0.25	0.34	0.43

contract breach" for a review), and we investigate our results' robustness to two alternative measures.

First, in the paper, we operationalise the ideology-based psychological contract breach experienced by academics in a narrow way to capture the effect of academic values deterioration. However, academics might be loyal to the academic ideals and their own employing institution. Following this logic, the academic psychological contract breach experiences could arise from changes in academic values and contextual changes in their job organisation. We account for this broader definition by constructing a composite numeric index that includes seven items listed as described in section "Measuring ideology-based psychological contract breach". These items are *(1) teaching responsibilities; (2) administrative responsibilities; (4) being unable to concentrate on my research; (8) the inadequate facilities or funding; (10) the feeling that sometimes my research is a waste of time; (11) the feeling that sometimes my research is a waste of public money; (12) It undermined my confidence in knowledge and science*. Therefore, the variable *ACADEMIC_BREACH* sums all the items indicated by the respondent and ranges between 0 (none of the items is selected) and 7 (all items are selected). This variable also allows us to account for the potential drawback of using only a dichotomous variable.

Second, we resort to a data-driven approach. Instead of deciding "a priori" which items measure the ideology-based psychological contract, we run a Principal Component Analysis (PCA) on all of them. Table 4 reports the four main components with eigenvalues above one, which explain most of the variance (see bottom of Table 4). The first component represents an ideology-based psychological breach of academic values because it has the highest correlation with the item *IDEOLOGY_BASED_BREACH* and related variables (*RESEARCH_WASTE_TIME*, *RESEARCH_WASTE_MONEY*. We call it

Table 5 Robustness Check

	Dependent variable:							
	USE_SCI-HUB							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FACULTY	−0.855***	−0.844***	−0.867***	−0.662***	−0.693***	−0.689***	−0.690***	−0.691***
	(0.0959)	(0.0961)	(0.0963)	(0.166)	(0.101)	(0.101)	(0.101)	(0.101)
FEMALE	−0.165*	0.136	−0.172*	−0.157	−0.219**	−0.210**	−0.223**	−0.214**
	(0.0963)	(0.170)	(0.0967)	(0.0968)	(0.0978)	(0.0975)	(0.0980)	(0.0982)
FOREIGN	0.352***	0.350***	0.868***	0.347***	0.309**	0.303**	0.322**	0.315**
	(0.123)	(0.123)	(0.211)	(0.123)	(0.125)	(0.126)	(0.125)	(0.126)
COPYRIGHT_KNOWLEDGE	0.138***	0.138***	0.137***	0.139***	0.139***	0.137***	0.138***	0.140***
	(0.0215)	(0.0215)	(0.0215)	(0.0215)	(0.0218)	(0.0219)	(0.0218)	(0.0219)
MORAL_JUSTIFICATION	0.367***	0.369***	0.370***	0.367***	0.364***	0.365***	0.364***	0.361***
	(0.0384)	(0.0384)	(0.0385)	(0.0384)	(0.0388)	(0.0388)	(0.0388)	(0.0388)
LIBRARY_SATISFACTION	−0.0770***	−0.0785***	−0.0780***	−0.0777***	−0.0764***	−0.0745**	−0.0765***	−0.0763***
	(0.0292)	(0.0291)	(0.0292)	(0.0293)	(0.0293)	(0.0293)	(0.0293)	(0.0294)
PAST_PIRACY	0.118***	0.118***	0.119***	0.119***	0.117***	0.117***	0.118***	0.118***
	(0.0201)	(0.0201)	(0.0201)	(0.0201)	(0.0202)	(0.0202)	(0.0202)	(0.0203)
COLLEAGUES_PIRACY_PERCEPTION	0.146***	0.147***	0.143***	0.146***	0.142***	0.143***	0.142***	0.142***
	(0.0237)	(0.0237)	(0.0238)	(0.0238)	(0.0240)	(0.0239)	(0.0240)	(0.0240)
TEACHING_LOAD	0.149	0.155	0.155	0.175	0.127	0.123	0.123	0.131
	(0.168)	(0.169)	(0.167)	(0.171)	(0.197)	(0.197)	(0.196)	(0.196)
INSTITUTIONAL_TRAINING	0.0376	0.0371	0.0390	0.0378	0.0384	0.0364	0.0378	0.0366
	(0.0416)	(0.0415)	(0.0417)	(0.0415)	(0.0419)	(0.0419)	(0.0419)	(0.0418)
UNETHICAL_PUBLISHERS	0.298***	0.294***	0.307***	0.295***	0.273***	0.267***	0.275***	0.274***
	(0.0927)	(0.0929)	(0.0931)	(0.0928)	(0.0936)	(0.0938)	(0.0936)	(0.0936)
ACADEMIC_BREACH	0.154***	0.224***	0.214***	0.209***				
	(0.0407)	(0.0518)	(0.0454)	(0.0570)				
RESEARCH_BREACH (PC1)					0.222***	0.272***	0.241***	0.282***
					(0.0362)	(0.0459)	(0.0400)	(0.0509)

Table 5 (continued)

	Dependent variable:							
	USE_SCI-HUB							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
COLLEAGUES_BEHAVIOUR (PC2)					0.00560	0.00878	0.00626	0.00715
					(0.0400)	(0.0400)	(0.0400)	(0.0402)
SENIOR_DISCONTENT (PC3)					−0.0260	−0.0275	−0.0285	−0.0337
					(0.0411)	(0.0412)	(0.0412)	(0.0414)
LACK_OF_TIME (PC4)					0.168***	0.169***	0.171***	0.163***
					(0.0486)	(0.0487)	(0.0485)	(0.0487)
FEMALE=1 X ACADEMIC_BREACH		−0.173**						
		(0.0790)						
FOREIGN=1 X ACADEMIC_BREACH			−0.307***					
			(0.0996)					
FACULTY=1 X ACADEMIC_BREACH				−0.115				
				(0.0795)				
FEMALE=1 X RESEARCH_BREACH (PC1)						−0.117*		
						(0.0700)		
FOREIGN=1 X RESEARCH_BREACH (PC1)							−0.0905	
							(0.0878)	
FACULTY=1 X RESEARCH_BREACH (PC1)								−0.128*
								(0.0727)
COUNTRY	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ERC	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
UNIVERSITY	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OBSERVATIONS	2701	2701	2701	2701	2701	2701	2701	2701

Notes: The dependent variable is a dummy equal to 1 if respondent used Sci-Hub in the past and 0 otherwise. Models are estimated using a logit model and the coefficients are reported. Robust standard errors in parentheses.

Legend: *$p<0.1$; **$p<0.05$; ***$p<0.01$

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RESEARCH_BREACH because it is also positively and strongly correlated with variables hinting to an increase in competition and stress also related to heavy publication pressure to progress in the career (e.g. competition load, career stress) while negatively or mildly related to those more likely to impact senior faculty members (e.g. teaching and administrative load, lack of research time). We use the other components of the PCA as additional control variables that might account for another type of contract breach.

Table 5 shows the results for equations 1 and 2 using the two definitions of an ideology-based psychological contract breach of academic values defined above. Table 5 confirms our previous results, showing the strong effect of an ideology-based psychological contract breach related to academic values in increasing the likelihood of scholars using Sci-Hub (**RQ1**).

In particular, columns 1–4 indicate that one unit increase of *ACADEMIC_BREACH* increase the odds of using Sci-Hub between 17% and 25%. Looking at the interaction terms in columns 2 and 3 of the variable with the moderators *FEMALE* and *FOREIGN*, we find that they are both negative and different from zero at 1% significance level, supporting **RQ2** and **RQ3**.

Also, the variable *RESEARCH_BREACH* shows a sizable effect on the use of Sci-Hub. Columns 5–8 show that a one-unit increase in *RESEARCH_BREACH* is associated with an increase between the 25 and 33 percent in the odds of using Sci-Hub. Additionally, the variable interaction with the moderators *FEMALE* and *FACULTY* (columns 7–8) provide support for previous results for **RQ2** and **RQ4**. The coefficients are indeed both negative and statistically significant at 10% significance level.

Discussion

In this paper we have developed and tested a theoretical framework that investigates the deep causes of research-related misconduct. Our results highlight the relationship between ideology-based psychological contract breach and misconduct. They help the development of a framework to address the growing issue of research-related misconduct in academia beyond anecdotes and opinion surveys. We have focused empirically on a mild transgression where genuine responses are easy to obtain. Moreover, while using Sci-Hub does not directly harm universities, its use can be associated with reputational and technical costs. Besides the potential security concern that illegal downloads pose to a university's digital infrastructure,[13] Sci-Hub usage is pretty unnoticed by universities. Illegal access to scientific literature through Sci-Hub can be considered a mild research-related misconduct. However, we documented its pervasiveness, as almost half of the scholars in Europe download papers illegally using Sci-Hub while doing research. This broad diffusion suggests acceptance of such mild misconduct beyond reasons of journal access. While transgressions towards third parties might be easily overlooked, they diffuse quickly and are relevant since they might precede the emergence of a slippery slope, causing more serious misconduct. Focusing attention on such minor transgressions and designing effective prevention policies could be effective in avoiding subsequent major ones.

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[13] See, for example, the article of Alexander Martin, a Technology reporter for Sky News. Available at https://news.sky.com/story/police-warn-students-and-universities-against-using-the-pirate-bay-of-science-12250407; last access July 2023.

Our results suggest that while designing policies preventing academic digital piracy, administrators and policymakers should consider the role of academic values and the connected intrinsic ideological currency so crucial for academics. Any university policy attempting to restore academic values (e.g. contrasting the "publish-or-perish" paradigm promoting freedom of research or releasing pressure from bibliometric indicators) might produce a policy spillover into preventing academic piracy and other research-related misconduct. There are only a few initiatives to restore academic values or decrease the emphasis on bibliometric indicators. For example, the national and international initiatives DORA and COARA[14] developed alternative ways to assess the quality of scientific output. However, the economics of science literature has started investigating two intervention areas to lift some "publish-or-perish" pressure. Such as moving beyond bibliometric measures and creating incentives for funding risky research,

Concerning alternative metrics, many advocate for better data (Molas-Gallart & Ràfols, 2018; Mas-Bleda & Thelwall, 2016) addressing name disambiguation (Sanyal et al., 2021; Han et al., 2004), self-citations (Schreiber, 2007; Szomszor et al., 2020), citations meaning (Budi & Yaniasih, 2022), and authors' contribution (Shen & Barabási, 2014). Beyond the scientific effort to correct biases in diffused bibliometric indicators, publishers still retain a central role in developing better metrics. Their improvements and a more critical use that accounts for their limitations can restore more trustworthy relations between academic management, publishers, and scholars (Biagioli, 2020). Utrecht University is undergoing an experiment to reduce the emphasis on bibliometric indicators. In June 2021, the University formally abandoned the journal impact factor metric when making faculty hiring and promotion decisions, and in 2023 decided to withdraw from the international rankings.[15] While it will take some time to evaluate all the effects of this bold decision, some scholars are already sceptical about the decision as the University has yet to identify an alternative measure of scientific performance (Singh Chawla, 2021).

Concerning funds for risky research, the economics of science literature (Wang et al., 2017; Franzoni et al., 2022) has highlighted funding agencies' risk aversion and bias against novelty. Established in 2007, ERC grants should fund curiosity-driven (i.e. characterised by high risk and high gain) research; however, their implementation systematically disadvantages novel and high-risk proposals of young scholars (Franzoni et al., 2022). Incentivising curiosity-driven research through their funding might help to restore academic values. Comparing two funding schemes in life sciences (NIH vs HHMI), Azoulay et al. (2011) found that funding schemes and incentives matter. The HHMI funding, which emphasises research freedom and creativity, has a long-term focus, promotes intellectual experimentation, and provides feedback, generates more breakthrough innovations than traditional funding (like NIH). Moreover, the effect on innovative performance is significant, as predicted by the idea that academic values matter to scholars. Indeed, research freedom and the ability to pursue curiosity-driven research are valuable for scholars and affect their behaviour, performance, and eagerness towards misconduct.

Even if not strictly related to workplace policy evaluation, our findings help scientific publishers and universities design measures against mild research-related misconduct. We highlighted the link between a deterioration of academic values and digital piracy, hinting at novel ways to address mild misconduct. Beyond improving access to scientific resources, diminishing the emphasis on bibliometric indicators, promoting risky and curiosity-driven

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[14] For more information see: https://coara.eu/agreement/faq/

[15] Additional information about the decision are at https://www.uu.nl/en/news/why-uu-is-missing-in-the-the-ranking; last access February 2023.

research, and developing new career evaluation tools will decrease the likelihood of experiencing an ideology-based psychological contract breach of academic values and break the negative spiral that might lead to research-related misconduct.

Finally, our investigation of moderating factors also contributes to designing effective prevention policies by identifying worker characteristics that impact the likelihood of engaging in academic piracy. Historically marginalised workers in the academic job market respond differently to ideology-based contract breach. Their experience of discrimination and resilience when experiencing ideology-based contract breach makes these groups less sensitive and prone to misconduct.

These different responses to the ideology-based contract breach call for targeting specific prevention policies for these categories. For example, a piracy prevention policy accompanied by an inclusion policy promoting the participation of women and foreigners in academia might generate an environment less prone to such behaviours. Our results indicate specific patterns for non-tenured scholars that should guide targeted prevention policies. Any policy designed to reduce job insecurity (e.g. career counselling, planning of staff turnover) might help prevent such forms of mild misconduct.

Conclusion

The academic profession has changed dramatically in the last decades. On the one hand, increased bureaucratization, metrics and evaluations, funding pressure, and the publish-or-perish paradigm threaten academic values and generate a growing sense of discontent and disenchantment towards scientific research. For example, a recent article in Nature documents this loss of faith in the academic research reporting several interviews (Gibney, 2022). In one of those, Felicity Callard, Professor at Glasgow University, said *"This sector reached the end of the road. The conditions under which people are working are unsustainable"*. On the other hand, in academia, there is growing evidence of research-related misconduct and scandals, as the well-known case of Stapel (Bhattacharjee, 2013). However, there is no systematic research to understand why these behaviours are spreading (Holtfreter et al., 2020) and whether they relate to transformations in the profession.

To spur in this direction, in this paper, we have used the organizational psychology literature to develop a theoretical framework that goes beyond anecdotal evidence and examines the deep causes of research-related misconduct. Additionally, we have tested our framework on a representative sample of European scholars focusing on a mild research misconduct: the use of Sci-Hub. The latter has three main motivations: i) mild and accepted misconducts are perceived as armless and non morally wrong, for this, in those cases, it is easier to obtain truthful answers; ii) in our particular case, the use of Sci-Hub is popular in rich universities irrespective of income and access (Till et al., 2019; Travis, 2016), suggesting the existence of a deeper cause for using it; and ii) past literature highlights that mild misconducts often create a slippery slope and a fertile ground for more serious misconduct. Indeed, the Sci-Hub platform distributes research materials obtained illegally that scholars use while doing research. Thus, using Sci-Hub represents a mild research-related misconduct since scholars can use their library resources or contact the authors to obtain a copy of the paper they need without using the platform. Besides this consideration, we have considered that some have no alternatives, no library access or budget, no time, or they might engage in boycott activities against publishers and the nexus between ideology-based contract breach and the use of Sci-Hub remains.

Indeed, the empirical analysis indicates, that while illegal access to scientific literature through Sci-Hub is a mild illegal misconduct, it is pervasive. Almost half of the scholars in European universities download papers obtained illegally using Sci-Hub. Looking at the determinants of this misconduct, we found that experiencing an ideology-based psychological contract breach related to the deterioration of academic values increases the likelihood of indulging in misconduct with a sizeable effect. Additionally, we found that the magnitude of the effect depends on contextual and demographic characteristics. Females, foreign and tenured scholars are less likely to respond with digital piracy when experiencing an ideology-based contract breach. We recognise that sometimes researchers have no alternatives since journal access is not always available or easy and our results are confirmed on top of it since we controlled for those factors.

This paper made both theoretical and empirical contributions. Regarding the theory, we bridged the organisational psychology literature with the literature on the economics of science, providing a testable set of hypotheses related to research-related misconduct. In particular, we examined the role of ideology-based psychological contract breaches in eliciting misconduct in academia. Using both streams of literature is pivotal to investigating profession-specific issues concerning misconduct and its prevention. Besides its specificity and limitation, our results contribute to the empirical literature on research misconduct in three ways. First, we shed light on a mild research-related transgression, examining its antecedents and determinants. We analysed a form of misconduct that goes unnoticed because using Sci-Hub to download scientific papers violates copyrights and harms (mostly) scientific publishers. Second, we examined the role of ideology-based psychological contract breaches in eliciting mild research-related misconduct. Analysing ideology-based psychological contract breaches helps define misconduct prevention policies based on profession-specific needs and characteristics. Our questionnaire does not allow us to distinguish the extent to which personal academic discontent stems from the perception of colleagues' misbehaviour or to more local issues. This could be an interesting addition to future research since research on Mertonian norms often found that most scholars consider distant colleagues as responsible for misbehaviour and norms violations (Anderson et al., 2010). Besides this consideration, it still holds that a general discontent related to a perceived deterioration of academic values exists, and any policy aiming to restore the core of academic values might also have the unintended but desirable effect of reducing copyright violations. Third, we investigated whether group factors such as demographic or contract characteristics moderate the link between misconduct and ideology-based psychological contract breach. We test if potentially discriminated groups in the job market (i.e. females and foreign) and those with job security (i.e. faculty members) are less responsive regarding misconduct when they experience ideology-based psychological contract breach. Identifying groups of workers more/less resilient to the effect of psychological contract breach in eliciting misconduct might help define target groups for prevention policies and create a better work environment.

Appendix A: Our Sample

Table 6 shows the list of universities included in our sample. The table shows university statistics and information. We sent our survey to the entire population of individuals working at universities in this list.

Table 7 examines the representaviveness of our sample in comparison to the different European university systems.

Table 6 List of Universities

Name	N. emails	Country	City	Founded	THE Rank	N. Students	Student/Staff	% Int Students	Soc. Sci.	Hum.	Life Sci.	Eng.	Med.
Heidelberg University	9597	Germany	Heidelberg	1386	42	20,020	14.5	18%	1	1	1	1	1
Humboldt University of Berlin	4633	Germany	Berlin	1810	80	33,388	56.3	18%	1	1	1		1
LMU Munich	1996	Germany	Munich	1472	32	34,249	33.6	17%	1	1	1		1
Technical University of Munich	4793	Germany	Munich	1868	41	32,377	39.8	31%	1		1	1	1
University of Tübingen	4503	Germany	Tubingen	1477	78	27,590	36.6	14%	1	1	1		1
Budapest University of Technology and Economics	2635	Hungary	Budapest	1782	1001+	19,415	17.7	11%	1			1	
Eötvös Loránd University	2687	Hungary	Budapest	1635	601–800	27,199	14.8	10%	1	1	1		
University of Debrecen	1084	Hungary	Debrecen	1538	801–1000	26,938	14.1	21%	1	1	1	1	1
Delft University of Technology	7065	Netherlands	Delft	1842	78	19,594	17.1	31%	1	1	1	1	1

Table 6 (continued)

Name	N. emails	Country	City	Founded	THE Rank	N. Students	Student/ Staff	% Int Students	Soc. Sci.	Hum.	Life Sci.	Eng.	Med.
University of Pécs	2657	Hungary	Pecs	1912	601–800	16,798	11.7	24%	1	1	1	1	1
University of Szeged	1544	Hungary	Szeged	1872	801–1000	18,859	12.1	20%	1	1	1	1	1
Maynooth University	1489	Ireland	Maynooth	1997	401–500	10,107	28.6	12%	1	1	1	1	
National University of Ireland, Galway	1187	Ireland	Galway	1845	301–350	14,453	26.6	18%	1	1	1	1	1
Trinity College Dublin	5437	Ireland	Dublin	1592	155	17,154	21.4	32%	1	1	1	1	1
University College Cork	1423	Ireland	Cork	1845	301–350	17,051	17.6	19%	1	1	1	1	1
University College Dublin	1633	Ireland	Dublin	1854	251–300	23,148	23.2	30%	1	1	1	1	1
Sapienza University of Rome	6566	Italy	Roma	1303	201–250	77,496	22.9	7%	1	1	1	1	1
University of Bologna	11,761	Italy	Bologna	1088	167	67,298	24.4	12%	1	1	1	1	1
University of Milan	8602	Italy	Milano	1924	351–400	45,752	20.9	6%	1	1	1	1	1

Table 6 (continued)

Name	N. emails	Country	City	Founded	THE Rank	N. Students	Student/ Staff	% Int Students	Soc. Sci.	Hum.	Life Sci.	Eng.	Med.
University of Padua	3252	Italy	Padova	1222	251–300	46,900	21.7	7%	1	1	1	1	1
University of Trento	3793	Italy	Trento	1962	301–350	13,180	20.1	7%	1	1	1	1	
Erasmus University Rotterdam	2224	Netherlands	Rotterdam	1913	72	26,453	26.8	22%	1	1	1		1
Leiden University	4158	Netherlands	Leiden	1575	70	30,178	19	18%	1	1	1		1
University of Amsterdam	7337	Netherlands	Amsterdam	1632	66	24,747	12.8	24%	1	1	1		
Utrecht University	6252	Netherlands	Utrecht	1636	75	32,022	14	10%	1	1	1		
Karolinska Institute	191	Sweden	Stockholm	1810	36	7,696	8.8	26%	1	1	1		1
Lund University	9214	Sweden	Lund	1666	103	27,443	11.3	19%	1	1	1		
Stockholm University	3879	Sweden	Stockholm	1878	183	27,200	19.1	10%	1	1	1		
University of Gothenburg	2726	Sweden	Gothenburg	1891	191	19,616	9.8	13%	1	1	1		1
Uppsala University	6115	Sweden	Uppsala	1477	111	25,112	15.8	18%	1	1	1	1	1

Table 7 Representativeness of the sample compared with Eurostat data

Country	N	Our sample
Center European System		
Germany	457,457	
Belgium	34,454	
Luxembourg	1435	
%	30%	16%
Northern European System		
Denmark	25,324	
Netherlands	72,900	
Finland	16,157	
Sweden	37,318	
%	9%	17%
Anglosaxon system		
Ireland	9275	
UK	217,004	
%	14%	13%
Southern European System		
Austria	61,818	
Greece	17,049	
Spain	175,019	
France	116,183	
Portugal	35,549	
Italy	96,581	
Cyprus	3523	
Malta	2085	
%	31%	33%
Eastern European System		
Latvia	6936	
Lithuania	10,163	
Estonia	4195	
Hungary	25,174	
Poland	96,719	
Romania	26,429	
Slovenia	7455	
Slovakia	11,794	
Bulgaria	20,894	
Czechia	19,088	
Croatia	18,167	
%	15%	6%

Notes: The aggregation of geographic areas are based on similarities of the university systems in terms of organizations and norms. Academic staff data are those in 2020 according to Eurostat https://ec.europa.eu/eurostat/databrowser/view/EDUC_UOE_PERP01__custom_2988094/default/table?lang=en

Appendix B: Additional Robustness

Knowing Sci-Hub is a prerequisite to using it; controlling for this could strengthen the results. Unfortunately, we do not have such a question in the survey; however, we ask, *"Have you ever discussed using SCI-HUB with your colleagues? (No, Maybe, Yes)"*. Discussing Sci-Hub imply to know it; therefore, we include the variable *DISCUSSED_SCI_ HUB* as a robustness check. We do not include this exercise in the main analysis as this variable is only a partial representation of knowing Sci-Hub, and this "mismatch" generates some issues. For instance, while discussing Sci-Hub indicates knowing it, it is less clear how to interpret it for the academics not discussing it. It might well happen that someone knows about Sci-Hub, but she did not discuss it with her colleagues. Table 8 column 1 shows that the variable is statistically significant at a 1% significance level. Including the variable reduces the significance of our variable of interest. However, the magnitude of the effect remains at the same level.[16] Concerning the loss of significance of some controls while adding the variable *DISCUSSED_SCI_HUB*, the results hint at multicollinearity as all the insignificant controls are strong predictors of discussing Sci-Hub. Despite these issues, we complete this robustness check, testing all the hypotheses (column 2–4). The effect of our primary variable, *IDEOLOGY_BASED_BREACH*, remains strong and statistically significant. Additionally, the interaction terms are aligned with the results presented in the primary model except the case of Female (column 3), which is now significant at a 10%. However, given the econometric issues of this model, we do not consider the results reliable and we therefore stick to the ones obtained in section "Empirical results".

Table 9 columns 1 and 2 explore the robustness of our results considering the intensity of Sci-Hub usage. Our sample has a more granular question that asked *"How many times you downloaded a paper using Sci-Hub last year"* with five possible answers: "zero", "at least one", "2–5", "5–10", "more than 10". Figure 4 shows that usage intensity is skewed, and those who use it tend to do it frequently; this is why our preferred model is with a dichotomous variable. However, the Poisson (column 1) and the Ordered Logit (column 2) models used to estimate the models using Sci-Hub intensity as the dependent variable present consistent results.[17] The estimates of our main variable *IDEOLOGY_BASED_ BREACH* are stable and statistically significant at 1% significance level. Unreported estimations also indicate that the interactions' results are robust to the different dependent variables and estimation methods. Finally, column 4 examines how the results change, considering an additional definition of contract breach. The added measure is the total number of negative items selected for the 13 presented items (*TOTAL_BREACH*). We should also note that those include general contract breaches not specific to academia. Besides the mentioned concern, the result in Column 3 confirms the association between contract breach and the use of Sci-Hub, even if with a smaller coefficient.

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[16] The marginal effects of using Sci-Hub for each level of "IDEOLOGY_BASED_BREACH" while holding the other variables at their means change from 0.599 to 0.572 for those experiencing an "IDEOLOGY_ BASED_BREACH" and from 0.461 to 0.494 for those not using it.

[17] Results on usage intensity are consistent also when adding the variable *DISCUSSED_SCI_HUB* See Table 8 column 5.

Table 8 Additional regressions results exploring the robustness of our results to a proxy of Sci-Hub knowledge

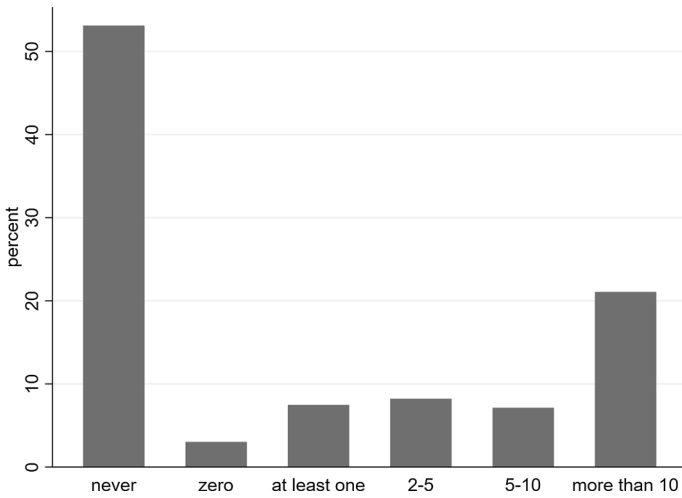|	LOGIT				ORDERED LOGIT
	Dependent Variable:				
	USE_SCI_HUB:				SCI_HUB_INT
	(1)	(2)	(3)	(4)	(5)
FACULTY	−0.480***	−0.416***	−0.482***	−0.488***	−0.305***
	(0.113)	(0.118)	(0.114)	(0.114)	(0.0933)
FEMALE	−0.190*	−0.189*	−0.256**	−0.199*	−0.133
	(0.115)	(0.115)	(0.122)	(0.115)	(0.0951)
FOREIGN	0.445***	0.443***	0.453***	0.521***	0.462***
	(0.145)	(0.145)	(0.145)	(0.151)	(0.115)
COPYRIGHT_KNOWLEDGE	0.0564**	0.0571**	0.0573**	0.0574**	0.0274
	(0.0262)	(0.0262)	(0.0262)	(0.0262)	(0.0208)
MORAL_JUSTIFICATION	0.304***	0.306***	0.304***	0.305***	0.303***
	(0.0466)	(0.0467)	(0.0467)	(0.0466)	(0.0383)
LIBRARY_SATISFATION	−0.0484	−0.0495	−0.0488	−0.0478	−0.0851***
	(0.0339)	(0.0341)	(0.0340)	(0.0340)	(0.0278)
PAST_PIRACY	0.114***	0.114***	0.115***	0.113***	0.101***
	(0.0243)	(0.0244)	(0.0244)	(0.0243)	(0.0205)
COLLEAGUES_PIRACY_PERCEPTION	0.0589**	0.0585**	0.0578**	0.0577**	0.0915***
	(0.0285)	(0.0286)	(0.0285)	(0.0285)	(0.0239)
TEACHING_LOAD	−0.00339	−0.00877	0.00458	−0.00995	0.0586
	(0.199)	(0.201)	(0.200)	(0.200)	(0.152)
INSTITUTIONAL_TRAINING	−0.0157	−0.0154	−0.0149	−0.0179	−0.0354
	(0.0493)	(0.0493)	(0.0495)	(0.0494)	(0.0394)
UNETHICAL_PUBLISHERS	0.0761	0.0678	0.0742	0.0769	0.184**
	(0.110)	(0.110)	(0.110)	(0.110)	(0.0901)
DISCUSSED_SCI_HUB	1.507***	1.510***	1.517***	1.510***	1.190***
	(0.0651)	(0.0651)	(0.0655)	(0.0652)	(0.0509)
IDEOLOGY_BASED_BREACH=1	0.312*	0.622**	−0.0119	0.477**	0.288**
	(0.187)	(0.246)	(0.256)	(0.210)	(0.142)
IDEOLOGY_BASED_BREACH=1 X FACULTY=1		−0.784**			
		(0.396)			
IDEOLOGY_BASED_BREACH=1 X FEMALE=1			0.667*		
			(0.359)		
IDEOLOGY_BASED_BREACH=1 X FOREIGN=1				−0.917**	
				(0.409)	
COUNTRY	Yes	Yes	Yes	Yes	Yes
ERC	Yes	Yes	Yes	Yes	Yes
UNIVERSITY	Yes	Yes	Yes	Yes	Yes
OBSERVATIONS	2698	2698	2698	2698	2700

Legend: *$p<0.1$; **$p<0.05$; ***$p<0.01$

Fig. 4 Intensity of Sci-Hub use last year. The category "never" represents non Sci-Hub users, those who never used Sci-Hub

Table 9 Additional regressions results

	POISSON	ORDERED LOGIT	LOGIT
	Dependent Variable:		
	SCI_HUB_INT	*SCI_HUB_INT*	*USE_SCI_HUB*
	(1)	(2)	(3)
FACULTY	−0.205***	−0.683***	−0.809***
	(0.0282)	(0.0869)	(0.0966)
FEMALE	−0.0456	−0.169*	−0.215**
	(0.0279)	(0.0899)	(0.0971)
FOREIGN	0.104***	0.364***	0.317**
	(0.0339)	(0.107)	(0.124)
COPYRIGHT_KNOWLEDGE	0.0301***	0.109***	0.136***
	(0.00598)	(0.0191)	(0.0216)
MORAL_JUSTIFICATION	0.121***	0.386***	0.364***
	(0.0116)	(0.0366)	(0.0386)
LIBRARY_SATISFACTION	−0.0315***	−0.104***	−0.0742**
	(0.00796)	(0.0267)	(0.0295)
PAST_PIRACY	0.0365***	0.119***	0.117***
	(0.00614)	(0.0198)	(0.0202)
COLLEAGUES_PIRACY_PERCEPTION	0.0495***	0.164***	0.140***
	(0.00674)	(0.0220)	(0.0239)
TEACHING_LOAD	0.0907**	0.323**	0.120
	(0.0455)	(0.141)	(0.167)
INSTITUTIONAL_TRAINING	0.00872	0.0223	0.0428
	(0.0118)	(0.0371)	(0.0415)
UNETHICAL_PUBLISHERS	0.123***	0.398***	0.272***
	(0.0272)	(0.0841)	(0.0935)
IDEOLOGY_BASED_BREACH	0.139***	0.479***	
	(0.0395)	(0.128)	
TOTAL_BREACH			0.178***
			(0.0297)
COUNTRY	Yes	Yes	Yes
ERC	Yes	Yes	Yes
UNIVERSITY	Yes	Yes	Yes
OBSERVATIONS	2703	2703	2701

Notes: Column 1 and 2 explore the intensity of Sci-Hub use with a Poisson and an ordered logit model respectively. Column 3 shows model results using an alternative definition of contract breach

Legend: *$p<0.1$; **$p<0.05$; ***$p<0.01$

Data Availability Data are available upon request.

Declarations

Conflict of interest The authors declare that there exists no Conflict of interest, competing financial interest or personal relationships that could have appeared to influence the work reported in this paper.

Ethical Approval Ethics approval was obtained from the Joint Ethics Committee of the Scuola Normale Superiore and the Scuola Superiore Sant'Anna before the commencement of the study on the 11th of February 2021.

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