



# Understanding university-industry collaboration: a social exchange perspective on the entrepreneurial university

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## Abstract

The aim of this study is threefold: firstly, to assess how the support provided by universities for academic collaboration with the industry may foster collaborative behaviour, based on academics' perceptions of the benefits and costs of collaboration. Secondly, the research seeks to unravel the perceived benefits and costs of university-industry (U-I) collaboration among academic staff within three distinct Higher Education Institutes (HEI) located in three different countries. Thirdly, analyse the impacts of these perceived benefits and costs on U-I collaboration behaviour. To reach these purposes, this study used a quantitative approach involving 214 academic staff from three HEI located in Portugal, Poland, and Türkiye, who answered a questionnaire about their collaboration behaviours and their perceptions regarding support provided by the HEI and their personal benefits and costs of engaging in collaborative behaviour. Results from a partial least squares structural equation model (PLS-SEM) suggest that perceived support diminishes the costs and favours the benefits. Nevertheless, the perceived collaboration costs generally outweigh the benefits. Increasing U-I collaboration implies a more efficient support and the results from this study point to the need to design a system of extrinsic rewards benefiting the heavy collaborators.

**Keywords** Academic staff · University support · University-industry collaboration · Perceived benefits and costs · Social exchange theory

**JEL Codes** I23 · M52 · O30

## 1 Introduction

The role of universities has undergone significant transformations, influenced by factors such as open innovation (Audretsch, 2014). Particularly, the third mission of universities, emphasizing knowledge transfer and collaboration with industries, has gained prominence in recent years. Researchers like Audretsch and Belitski (2021), Cerver Romero et al. (2021), Etzkowitz (2016) and Guerrero et al. (2016) highlight how university-industry col-

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laboration has expanded the roles of academic staff, encompassing entrepreneurial research and the development of innovations for societal benefit. As we navigate economic transitions towards a more sustainable future, collaboration between academic research units and industries becomes paramount, leading to diverse outcomes like study reports, design artefacts, prototypes, patents, and even spin-offs (Perkmann & Walsh, 2007). Recognizing the pivotal role of academic staff in this collaboration process sets the stage for exploring the support mechanisms that universities can provide.

The role of university support in fostering an entrepreneurial university culture and influencing the collaboration behaviour of academic staff with industry has been a subject of increasing scholarly attention. Existing literature highlights the critical impact of supportive institutional structures and policies on the extent and nature of academic-industry collaborations, aligning with the broader concept of the entrepreneurial university (Foss & Gibson, 2015; Guerrero & Urbano, 2012). Studies have delved into various facets of university support, including financial resources, administrative frameworks, and strategic initiatives, and their influence on shaping the attitudes and behaviours of academic staff toward university-industry (U-I) collaboration, thereby contributing to the entrepreneurial ethos of the institution (Franco and Haase, 2015; Perkmann et al., 2013, 2021). Research suggests that a conducive university environment not only enhances the willingness of academics to collaborate with industry partners but also positively affects the quality and outcomes of such collaborations, positioning the university as an active participant in entrepreneurial endeavours (Foss & Gibson, 2015; Jones et al., 2020). Understanding the dynamics of university support in fostering academic behaviour is crucial for developing effective strategies to promote successful U-I collaboration and maximize the mutual benefits for both academia and industry (Perkmann et al., 2021).

The variability in the appeal and interest in U-I collaboration behaviour is influenced by diverse factors among academics, including their perceptions of the benefits and costs associated with such collaboration, as well as the support provided by the university to encourage such behaviour. Many studies delve into the individual and organizational factors that prompt academic staff to adopt an entrepreneurial role, considering elements like the benefits and costs associated with university-industry collaboration (Hayter, 2011, 2015; Jain et al., 2009). Despite the increasing focus on U-I collaboration in recent research (e.g., Mascarenhas et al., 2022), there remains a scarcity of empirical studies investigating the motivations behind the differential engagement of academic staff in this collaboration (e.g., Kilian et al., 2015) and the role of university support on the behaviour of academic staff in engaging with industry, specifically in U-I collaboration (e.g., Chen et al., 2019).

The review on academic engagement by Perkmann et al. (2021) indicates lack of evidence for a positive spillover of commercialisation. However, authors state that the evidence remains inconclusive about university-industry collaboration behaviour of academic staff and its impact on academic entrepreneurial activities, for which they suggest new empirical studies that seek to address this conspicuous gap in the literature.

Therefore, the present study accepted this challenge, and based on the framework of social exchange theory, it is expected that university-industry collaboration behaviours result from a positive attitude to cooperation developed when an academic perceives that the benefits overcome the possible costs. Accordingly, this paper seeks to evaluate three key aspects: (1) the mediating role of perceived benefits and costs in the relationship between university support and U-I collaboration behaviour of academic staff; (2) the perceived ben-

efits and costs of U-I collaboration from the academic perspective; and (3) the respective impacts of these perceived benefits and costs on U-I collaboration behaviour.

This work provides a triple contribution to the current body of literature. First, the analysis initially includes academic staff members who have previous experience in collaboration, as well as those who do not have such experience, from three different countries. This aligns with one of the new research directions suggested by Foss and Gibson (2015) and Perkmann et al. (2021): the inclusion of samples from multiple countries. Second, the predominant focus of past research on the entrepreneurial university has predominantly centred on societal and organizational levels as the primary units of analysis, with limited attention dedicated to understanding the dynamics at the individual and group levels within universities. This oversight presents an opportunity to enhance the organizational perspective through nuanced individual-level analyses, particularly by exploring the attitudes and behaviours of university members, including academic staff (Guerrero & Urbano, 2012). This study aims to address this gap by emphasizing the crucial role of academic staff in actively contributing to and shaping the entrepreneurial university through U-I collaboration behaviour. Third, the quantitative approach sets itself apart from various qualitative research by incorporating the dimension of university-industry collaboration behaviour and examining the influence of academics' perceived benefits and costs on this behaviour (Bjerregaard, 2009; O'Dwyer et al. 2022) and the role of the university support in U-I collaboration mediating by academics' perceived benefits and costs.

The paper is organised as follows. Section 2 reviews and discusses briefly the literature on entrepreneurial university and U-I collaboration: behaviour and perceptions of benefits and costs. Section 3 gives details of data collection and methodology. Section 4 discusses the results of the partial least squares structural equations model (PLS-SEM). We conclude by discussing the implications of our results against the context of the existing literature, and deriving some policy conclusions.

## 2 Theoretical background

### 2.1 The entrepreneurial university

An entrepreneurial university (Clark, 1998) must fulfil three core missions: education, research, and a contribution to society (Abreu et al., 2016), commonly referred to as the third mission of universities. This contribution aims to disseminate knowledge to society and organisations, as well as foster entrepreneurial skills, innovation, social welfare, and human resource development. As stated by Audretsch (2014) Humboldt University expands its academic endeavours by incorporating an extra dimension of scholarly pursuit. This new strand is dedicated to addressing and resolving significant societal challenges or specific facets thereof, with a primary emphasis on practical answers and applications. The university's third mission has been shaped over the past few decades through policy discussions involving the university, industry, government, and society (Giuri et al., 2019), namely the technology transfer within a quadruple helix framework (Miller et al., 2018).

As posited by Audretsch (2014), the involvement of universities in an entrepreneurial society transcends the mere transfer of knowledge and technology. In the context of a society that values and promotes entrepreneurship, the primary objective of the university is to

actively participate in and spearhead the cultivation of entrepreneurial mindset, behaviours, establishments, and the accumulation of resources that facilitate entrepreneurial activities, as conceptualised by Audretsch et al. (2006) as “entrepreneurship capital”.

The concept of “entrepreneurship capital” serves as a valuable framework for elucidating the contrasting nature of the entrepreneurial university and the university’s role in fostering an entrepreneurial society (Audretsch, 2014). The author’s examination of the dichotomy between the two distinct categories of universities offers a thought-provoking viewpoint. The advent of the entrepreneurial university is the recognition of the imperative to establish novel interdisciplinary and research domains that are exclusively focused on addressing distinct societal dilemmas and obstacles. Within the context of this particular scenario, it is worth noting that the allocation of resources within the university is such that only a limited number of areas are specifically designated and devoted to fulfilling this particular purpose. Moreover, an entrepreneurial university can provide new alternatives to the university community, which typically identifies entrepreneurial opportunities.

Audretsch (2014) asserts that universities not only provide commercializable knowledge and qualified research scientists, but also have other effects, such as attracting new businesses, creating employment opportunities, recruiting talented individuals, and proactive engagement aimed at augmenting entrepreneurial capital, promoting collaborations with local, regional, and international entities. In the present context, a considerable number of facets within the university ecosystem are instrumental in fostering the accumulation of entrepreneurial capital. Although not often directly, these aspects work by accepting and encouraging a culture that values the unrestricted pursuit of knowledge and creativity. Furthermore, this culture is based on the realisation that the impact of these ideals extends beyond the boundaries of the university.

Implementing the university’s third mission, which may involve establishing university-industry (U-I) collaborations, is a complex undertaking. The issues arise from the clash between academic and commercial demands (West, 2008). These tensions emerge from differing research agendas (Ankrah et al., 2013), such as the industry’s preference for less risky and commercially feasible research over academia’s more unpredictable outcomes. Universities value transparency, while businesses value intellectual property and control (Ambos et al., 2008; Tartari et al., 2012). Therefore, University has to carefully look at both individual and organisational factors, as well as outside factors such as the current state of the local economy and the ease of access to technological, human, and financial resources (Muscio & Vallanti, 2014). Additionally, it has been noted that promoting entrepreneurship through policy measures requires an organisation to have an entrepreneurial mindset that is clear to all potential stakeholders (Siegel et al., 2003).

## 2.2 University-industry collaboration

It is remarkable the relevance that academic research plays in encouraging innovation (George et al., 2002; Philpott et al., 2011). The literature identifies the importance of universities as primary sources of new scientific and technological knowledge and recognises the value of this role (Audretsch, 2014; Wright, 2007). In addition, it is believed that the relationships between industry and academia are extremely important for gaining access to this knowledge. Furthermore, the collaboration between industry and universities enables

the exploitation of complementary skill sets, which has the potential to result in cost savings and enhancements to the quality of the research conducted (Hemmert et al., 2014).

Previous research has examined the factors that motivate and impede academics' collaboration with industry (Bjerregaard, 2009; Bruneel et al., 2010; Lee, 2000). Drawing on social exchange theory (SET), this study will focus on the personal perceptions of academics regarding the benefits and costs of U-I collaboration, in addition to their evaluation of the support rendered by their institution.

Stafford and Kuiper (2021) propose that the fundamental principle of social exchange theory is the consideration of costs and benefits in interpersonal interactions. Individuals assess the present and anticipated costs and advantages of starting or sustaining relationships and interpersonal interactions. This approach is based on the belief that research collaboration between faculty members and firms resembles a market, where partners engage in exchange behaviour (Lee, 2000).

The primary goal of SET is to predict and explain behaviours by understanding the factors (benefits and costs) involved in decision making. In these settings and concerning to University the social exchange theory is described as a collaborative effort involving two or more individuals, in which each individual possesses something that the other individual considers useful and the goal is to create something new. The goal of an exchange is to produce advantages for each participant by trading behaviours or goods that actors cannot acquire alone (Cook et al., 2013). Furthermore, the application of SET has demonstrated efficacy in clarifying university-industry relationships (Plewa et al., 2013; Sharma, 2022).

Researchers' willingness to engage in knowledge transfer efforts depends on how they evaluate the benefits and costs involved, when academic staff take part in collaborative efforts with industry, it is evident that they are involved in a reciprocal relationship of some nature (Lee, 2000). The involvement of academics plays a vital role in enabling knowledge exchange between universities and industry. By understanding the perspectives of academics on the challenges that hinder industry engagement, as well as their perceptions of the involvement and support offered by universities, one can gain insights into the traits and incentives that drive collaboration between universities and industries (Owen-Smith & Powell, 2001).

### **3 Hypotheses and research model**

#### **3.1 University support for university-industry collaboration**

Universities require novel strategic options to effectively support their third mission. These choices should enable them to promptly adapt to changes and foster an institution where U-I collaboration is endorsed and facilitated by all stakeholders, including academics (Ambos et al., 2008). It is recognised that organisational, regulatory, and working environments affect academics' technology transfer engagement at U-I collaboration (Skute et al., 2019).

On an organisational level, many motivations inspire U-I collaborations. The main motivation is to increase funds raised through supported research and consortium membership fees. Universities want to improve lab equipment and optimise staff and equipment use. Additionally, U-I collaborations have the potential to generate employment and internship opportunities, as well as provide a significant business opportunity, among other advantages

(Lee, 2000; Prigge, 2005). These factors will motivate entrepreneurial universities to provide support for collaborative endeavours with industry, which aid in the fulfilment of their mission.

Entrepreneurial universities are more likely to have incentive systems to reward U-I collaboration behaviour (Fini et al., 2011; Tornatzky et al., 2002), establish U-I collaboration as a criterion in the academic evaluation system for promotion/tenure (Plewa et al., 2006, 2013), dedicate more funding and other resources (lab equipment, grants, etc.) (Lee, 2000; Ramos-Vielba et al., 2016), foster the establishment of start-ups by students or staff (Galán-Muros et al., 2017), and encourage and support research R&D commercialisation (Ambos et al., 2008; Perkmann et al., 2013). They also develop diverse and interdisciplinary structures to support technology transfer, engaging the entire organisation, including hybrid units that serve as a bridge for collaboration with industry and other higher education institutions (e.g. technology transfer offices, incubators, etc.) (Aldridge & Audretsch, 2011; Etzkowitz et al., 2000). This support provided by universities allows some academics to perceive it as an incentive to collaborate with companies, which can be translated into economic benefits (e.g., funds for research, business opportunities, and personal income) and academic benefits (e.g., dissemination of knowledge, publication, networking, and career advancement) (Lee, 2000). Based on the aforementioned considerations, the following hypotheses can be derived:

**H1a** The perceived support provided by entrepreneurial universities fosters the perception of economic benefits of collaboration.

**H1b** The perceived support provided by entrepreneurial universities fosters the perception of academic benefits of collaboration.

The support provided by universities, as perceived by academics, has the potential to alleviate certain perceived costs associated with U-I collaboration. Specifically, it can mitigate administrative barriers such as excessive bureaucratic processes, insufficient support, and administrative duties. Additionally, it can address goal conflicts that may arise during collaboration, such as concerns regarding career progression and conflicts with teaching and research obligations (Muscio & Vallanti, 2014; Nsanzumuhire & Groot, 2020). Consequently, it is reasonable to hypothesize that:

**H2a** The perceived support provided by entrepreneurial universities diminishes the perception of administrative barriers to collaborate.

**H2b** The perceived support provided by entrepreneurial universities diminishes the perception of goal conflict in collaboration.

### 3.2 Benefits of collaboration

The synergy between academic researchers and industry can yield substantial advantages. The most positive effects of collaboration with industry are related to economic aspects and the acquisition of additional funding to support scholarly research. Tartari and Breschi

(2012) analysed survey data collected from 657 researchers in nine different scientific fields at three major Italian universities and found that the primary reason for the growing collaboration between academic researchers and industry is access to financial and nonfinancial resources. These include the sharing of equipment, materials, and human resources, as well as the development of social capital, e.g. network expansion, to support their academic research.

According to Lee (2000), many American faculty members receive support through the acquisition of funds. These funds are crucial in supporting graduate students and enabling the purchase of necessary lab equipment. In accordance with this line of thinking, Tartari et al. (2014) realised, in their survey of 1,370 academic scientists and engineers in the United Kingdom, that additional research funding was viewed as the most influential factor in industry collaboration. Therefore, it can be asserted that there is a direct relationship between academic engagement and the allocation of research funding and other resources (Arza, 2010; D'Este & Perkmann, 2011; Gulbrandsen & Smeby, 2005; Lee, 2000; Perkmann et al., 2011; Ramos-Vielba et al., 2016). In this study, economic benefits will be examined based on Lee's (2000) framework, which includes funding, personal income, and business potential. This line of arguments leads to the following hypothesis:

### **H3a** Economic benefits favour collaboration behaviour.

Baycan and Stough (2013) and O'Dwyer et al. (2022) argue that academics anticipate improved reputation as one of the benefits resulting from the collaboration between the University and Industry. The facilitation of interactive learning through close collaboration can indirectly enhance scientific production by fostering novel ideas and motivating new research endeavours. Hence, many academics engage in collaborative efforts with industry to advance their research activities (Perkmann et al., 2011, 2021; Tartari & Breschi, 2012). The predisposition of academicians to publish in applied journals positively affects their propensity to collaborate with industry, as demonstrated by Tartari and Breschi (2012). In the present investigation, academic benefits will be examined based on Lee's (2000) framework, which encompasses networking, dissemination, publication, and valuing the career. These benefits/drivers were also supported by Gulbrandsen and Smeby (2005), Muscio and Vallanti (2014) and O'Dwyer et al., (2022) findings. Based on the aforementioned reasoning, it is interesting to purpose:

### **H3b** Academic benefits favour collaboration behaviour.

## **3.3 Costs of collaboration**

Collaboration between universities and industry presents challenges or, as Muscio and Vallanti (2014) defined, academic goal conflicts. These conflicts emerge when collaboration clashes or hinders the advancement of one's career, academic pursuits, or the obligations and demands imposed by governmental initiatives.

A study, performed in the United Kingdom, revealed that academics, when collaborating with industry, frequently encounter transaction-oriented challenges such as restricted time and resources, bureaucratic procedures within academic institutions (Bruneel et al., 2010).

Nsanzumuhire and Groot (2020) conducted a literature review to analyse the perceived difficulties linked to University-Industry collaboration. The authors discovered that the biggest obstacle to collaboration between universities and industries was the lack of time for joint research projects. This was mostly due to the heavy workload connected with teaching, research, and administrative responsibilities (Plewa et al., 2006). Based on the aforementioned factors, we postulate that:

#### **H4a** Administrative barriers hinder collaboration behaviour.

The perceived role conflict between the traditional academic roles of teaching and research and the relatively new roles of entrepreneurial activities, including collaboration with industry, can be a major barrier to collaborate (Choi et al., 2023). Role conflict in academia is a well-known topic (Civera et al., 2024; Philpott et al., 2011). Choi et al. (2023) suggest that these conflicts hinder academics to view themselves as entrepreneurs, and this hindrance may be extended to other kinds of less central academic roles, such as industry collaboration. Markman et al. (2005) argued that faculty members may avoid U-I collaboration due to potential conflicts with tasks valued for tenure and promotion. Perceived detrimental effects on career progression and conflicts with teaching and research obligations are among the main obstacles identified by Muscio and Vallanti (2014) and by Nsanzumuhire and Groot (2020). It may thus be hypothesised that:

#### **H4b** Goal conflict hinders collaboration behaviour.

Although the benefits of collaboration may outweigh its costs, according to SET, academics will weigh the costs and benefits of collaboration thoroughly before engaging in it (Tartari et al., 2012).

The conceptual research model was crafted by drawing upon the insights gleaned from the comprehensive literature review presented in the preceding sections, with a particular emphasis on Social Exchange Theory. These frameworks played fundamental roles in shaping the research hypotheses that guide this study, resulting in the proposed conceptual research model illustrated in Fig. 1.

## **4 Methods**

A questionnaire measuring attitudes and behaviours was developed and applied to a sample of academics from three HEI in Portugal, Poland, and Türkiye to test the hypotheses. These three Higher Education Institutes (HEIs) actively participated in the ETEIA - Energy Transition Entrepreneurs in Action - European project (<https://kx7qnd.webwave.dev/>), where one of the objectives was to understand how to foster entrepreneurship among academic staff. The first package was to carry out a diagnosis of needs and competence gaps in the area of creativity, innovation and commercialisation of knowledge, considering students and academic staff. To fulfil this task, a questionnaire was developed for the students and another for the academic staff. The survey was held online (Limesurvey GmbH), and an invitation was distributed by email to a sample of 350 academics covering different scientific areas from the three institutions. After two recalls, a total of 214 questionnaires were completed



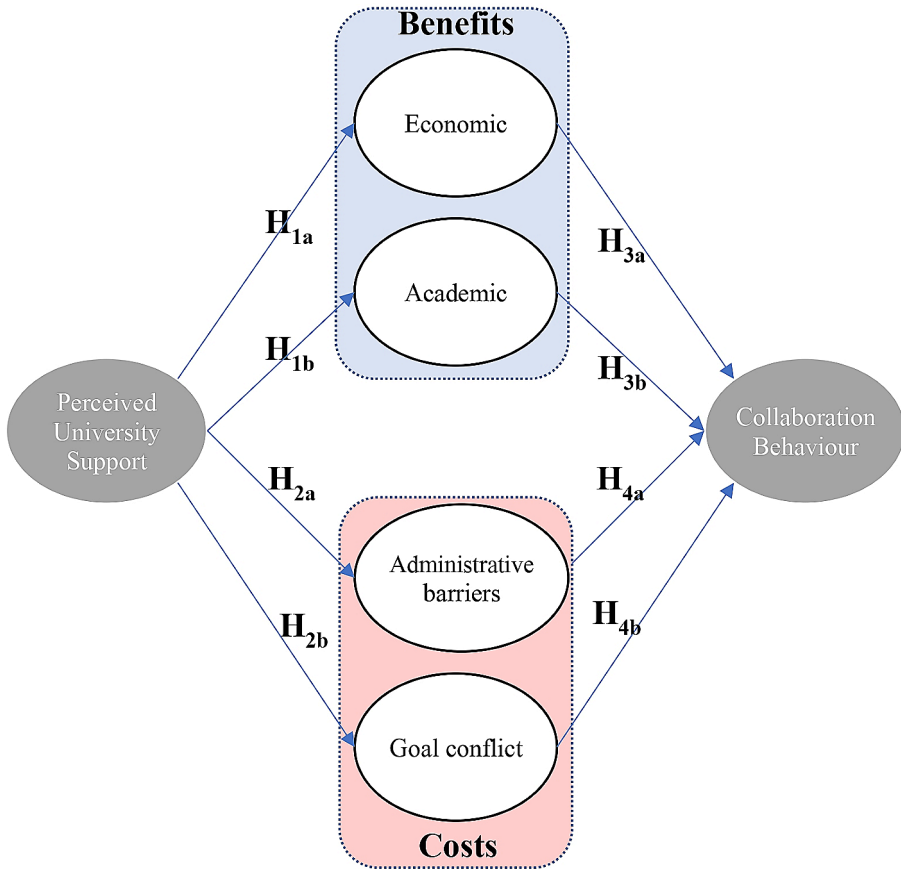


Fig. 1 Conceptual model

during January 2022, resulting in a 61% response rate. Due to challenges in gathering information from academic staff, a pragmatic decision was made to employ a convenience sample comprising 150 academics for each HEI.

The dependent variable is the weighted sum of six behaviours (Table 1): for each behaviour, the respondent will get a score of 2 if played a leading role, 1 if it was a supporting role, and 0 if neither. The time frame for considering the behaviours is the last five years. The list of behaviours was selected from a review by Nsanzumuhire and Groot (2020).

The perceived benefits and costs were measured by a Likert-type five-point intensity scale, labelled from “not at all” (1) to “substantially” (5). Respondents were asked to what extent they have experienced the benefits and costs during their academic career. Items for measuring economic and academic benefits were adapted from Lee (2000). Funding, personal income, and business opportunities are the three economic benefits, whereas the academic benefits are measured by four items: networking, dissemination, publication, and valuing the career. On the other hand, items for costs were derived from the literature on obstacles to collaboration (Muscio & Vallanti, 2014; Nsanzumuhire & Groot, 2020). Administrative barriers include excessive bureaucracy, heavy administrative duties, and

lack of administrative and/or technical support. Goal conflict arises when academics perceive that collaboration is not valued in job performance assessment and impedes engagement in valued tasks.

Finally, the exogenous variable representing the perceived support given by HEI to promote collaboration was assessed by four items developed by the research team, based on conclusions from Awasthy et al. (2020) and indications from Muscio and Vallanti (2014). Respondents evaluated support in a scale from “very poor” (1) to “very good” (5) regarding the following facets: motivating research oriented to collaboration with industry; supporting the commercialisation of the results from scientific research; supporting the creation of firms based on scientific research; rewarding academics for their collaboration with industry.

The perceived support, benefits, and costs, as well as the revealed behaviours were first assessed by descriptive statistics and their relationships evaluated in a partial least squares structural equations model (PLS-SEM) using SmartPLS 4 (Ringle et al., 2022).

## 5 Results

Regarding the behaviour, a striking result is that only 9% of respondents declare to be uninvolved with industry collaboration (Table 1). The majority of academics have been somehow involved with finding internships for students and/or grants for research involving enterprises. Consultancy and training also engage a considerable share of academics. Considering only the leading role, almost one in three academics has looked for internships; about one in five has provided consultancy or training; one in eight developed some innovation applied outside the university; only one in 100 lead a spin-off (Table 1), in line with the study of Davey and Galan-Muros (2020). Table 2 shows the average of collaboration scores in each country, suggesting that academics from the Portuguese institution tend to be less engaged in collaboration activities.

Concerning the perceived benefits and costs, it is noticeable from Table 2 that perceived benefits are lower than the perceived costs. The most extensively experienced cost is the burden of administrative barriers, revealing that respondents attribute more obstruction effect to the powerlessness to deal with bureaucracy. However, this cost dimension is much more salient in Portugal and Poland than it is in Türkiye. On the contrary, Portuguese academic staff seem to be more overwhelmed not only by the bureaucracy, but also by the perception on conflict between collaboration with the industry and their academic duties. Portuguese also perceive lower benefits, particularly in the economic dimension. Finally, with respect

**Table 1** Roles played by academics in collaboration behaviours

Behaviour	Leading		Supporting		Neither	
	n	%	n	%	n	%
Research grants	42	20	100	47	72	34
Finding internships	61	29	78	36	75	35
Consultancy	46	21	81	38	87	41
Training	43	20	76	36	95	44
Innovations	26	12	78	36	110	51
Spin-off	2	1	23	11	189	88
At least one of the above	170	79	194	91	20	9

**Table 2** Variable means

Variables / items	Country			
	Poland	Portugal	Türkiye	Total
<b>Support</b> (min 1 – max 5)	<b>2.939</b>	<b>2.654</b>	<b>3.533</b>	<b>2.971</b>
Research oriented to collaboration	3.333	2.871	3.778	3.276
Commercialisation of research	3.121	2.700	3.600	3.084
Firms based on research	2.909	2.757	3.556	2.995
Compensation for collaboration	2.394	2.286	3.200	2.528
<b>Benefits</b> (min 1 – max 5)	<b>2.403</b>	<b>2.048</b>	<b>2.299</b>	<b>2.265</b>
<i>Economic</i>	2.357	1.648	2.126	2.076
Funds for own research	2.545	1.917	1.867	2.196
Business opportunities	2.071	1.643	2.378	1.995
Personal income	2.455	1.386	2.133	2.037
<i>Academic</i>	2.619	2.332	2.600	2.521
Dissemination	2.636	2.471	2.222	2.495
Publication	2.687	2.100	2.333	2.421
Networking	2.636	2.300	2.756	2.551
Valuing career	2.515	2.457	3.089	2.617
<b>Costs</b> (min 1 – max 5)	<b>3.261</b>	<b>3.511</b>	<b>2.569</b>	<b>3.197</b>
<i>Administrative barriers</i>	3.498	3.714	2.630	3.386
Administrative duties	3.525	3.943	2.889	3.528
Insufficient support	3.172	3.414	2.467	3.103
Excessive bureaucracy	3.798	3.786	2.533	3.528
<i>Goal conflict</i>	2.904	3.207	2.479	2.914
Not valued in assessment	2.990	3.143	2.222	2.879
Less opportunities to publish	2.818	3.271	2.773	2.949
<b>Collaboration</b> (min 0 – max 12)	<b>5.440</b>	<b>4.810</b>	<b>5.470</b>	<b>5.240</b>

**Table 3** Reliability and convergent validity

	Measurement model	
	rho_A	AVE
<b>Benefits</b>		
Economic	0.730	0.777
Academic	0.849	0.677
<b>Costs</b>		
Administrative barriers	0.876	0.731
Goal conflict	0.709	0.756
<b>Perceived support</b>	0.778	0.900

rho\_A: constructs' reliability (reference value>0.7)  
 AVE: average variance extracted (reference value>0.5)

to perceived support, the worst score is given to compensation for collaboration. Academics from Türkiye perceive more support in every item.

Table 3 shows the measures of constructs' reliability (rho\_A) and convergent validity (AVE – average variance extracted). All five latent variables comply with the reference values, which are 0.7 for rho\_A and 0.5 for AVE. The measures also have discriminant validity, as assessed by the heterotrait-monotrait ratio of correlations (HTMT): all the ratios are below 0.85; the highest ratio is 0.843, between the two dimensions of perceived benefits (Table 4).

The correlations between latent variables (Table 4) are as expected: positive between the benefits and between the costs; insignificant between benefits and costs; positive between support and benefits, and negative between support and costs. The two kind of benefits are the only latent variables significantly correlated with the dependent variable.

Having established the reliability and validity of the measures, the assessment of the hypotheses is guided by the results of the structural model. The left side of Fig. 2 shows that the results are concordant with the first set of hypotheses, concerning the effects of university support, favouring the perception of benefits and diminishing the perception of costs. The perception of a supportive environment from the HEI accounts for  $\frac{1}{4}$  of the variance of how intensely academics perceive excessive bureaucracy and heavy administrative duties as barriers to collaborate with the industry. It also accounts for nearly  $\frac{1}{5}$  of the variance of the perceived goal conflict between collaboration and other valuable academic roles. The impact on perceived benefits of collaboration is relatively weak, with less than 10 per cent of explained variance.

On the other hand, from the right side of Fig. 2 it may be seen that only one of the effects behave as expected, confirming that perceived economic effects of collaboration are significant predictors of collaborative behaviour. Neither the academic benefits nor goal conflicts explain collaboration behaviour. The surprising result comes from  $H_{4a}$ . Instead of hindering collaboration, the perception of administrative barriers for engaging in it has a weak but significant positive effect on the magnitude of collaboration behaviours. A possible justification could be that more collaborative academics are also more productive overall (Perkmann et al., 2011), and naturally feel burdened by excess of activities and heavy workloads.

The lack of support for  $H_{4a}$ , resulting in a positive relationship where a negative would be logical, leads to a complex relationship between university support and collaboration behaviour. On one hand, by weakly promoting the perception of economic benefits, perceived support exerts a positive ( $\beta=0.083$ ,  $p=.016$ ) indirect effect on behaviour, as expected. On the other hand, by strongly diminishing the perception of administrative barriers, perceived support has a negative ( $\beta=-0.100$ ,  $p=.014$ ) indirect effect on behaviour. Summing the two contradictory effects, the influence of perceived support on behaviour is insignificant.

Overall the model accounts for 22% of the variation of collaborative behaviours between subjects. Therefore, other factors beyond the perception of benefits and costs would explain the different levels of collaboration. Given that the sample is composed by academics from three different countries, with some differences in perceptions and behaviour (Table 2), some contextual factors regarding the institutions and/or the countries, may also affect the collaboration beyond the modelled predictors. Nevertheless, one result should be stressed, given its relevancy: it is worth noting that the economic benefits are simultaneously the least performant ( $\mu=2.08$ ) and the most important ( $\beta=0.338$ ,  $f^2=0.09$ ) predictor of collaboration

**Table 4** Discriminant validity

	Economic benefits	Academic benefits	Administrative barriers	Goal conflict	Perceived support	Collaboration Behaviour
Economic benefits		<i>0.676</i>	-0.124	-0.175	<i>0.244</i>	<i>0.407</i>
Academic benefits	0.843		-0.070	-0.124	<i>0.280</i>	<i>0.341</i>
Administrative barriers	0.194	0.114		<i>0.552</i>	<i>-0.504</i>	0.102
Goal conflict	0.267	0.160	0.724		<i>-0.417</i>	-0.042
Perceived support	0.291	0.321	0.582	0.508		-0.030

Lower diagonal: HTMT (heuristic value<0.85); Upper diagonal: correlations (*italicised*:  $p<.001$ )

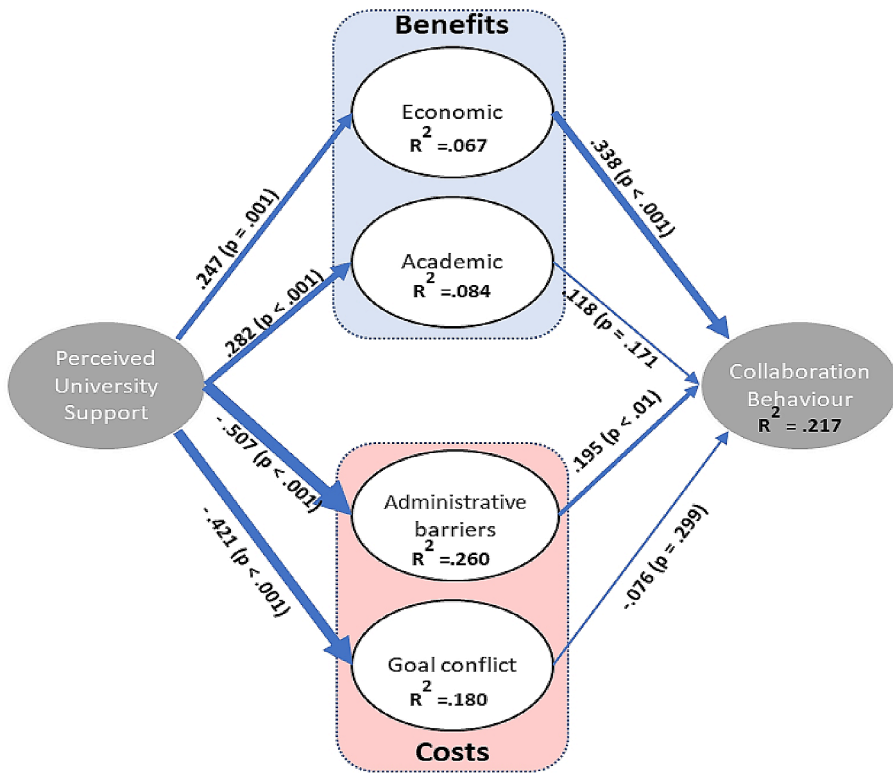


Fig. 2 Structural model (path coefficients and  $R^2$ )

behaviour. This suggests that economic incentives could be an effective way of increasing collaboration behaviour.

## 6 Discussion

Results suggest that academics from the three HEI seem to have only marginally benefited from collaboration with industry. Although this perception is more acute for the Portuguese institution, the perceived costs of collaboration generally overcome the benefits and the perceived support. The most relevant cost is the feeling of being deluged by administrative duties without sufficient support to deal with bureaucracy. Academics find themselves obstructed by the burden of administrative duties, but this perception is positively related to collaboration behaviours. One possible interpretation is that more proactive staff, cooperating with industry, are more likely to experience their organisation's inefficiencies and to put higher value on the time spent dealing with bureaucracy. However, the perceived cost is much smaller in one of the institutions, which is integrated in an industrial park, suggesting that ease of contact may drop the collaboration costs significantly. Contextual factors, including not only the cultural and political environment, but also the social and economic

networks in which the HEI are embedded, are critical for the effectiveness of U-I collaboration (Feola et al., 2021).

On the benefits' side, economic rewards, as prospects of income or as a means of research funding, are the only significant predictor of collaboration behaviours. Academics recognise some advantages networking and disseminating their research, but this perception has no impact on behaviour. Although there is a positive correlation between academic benefits and behaviour ( $r=.341, p<.001$ ), this relationship adds no predictive power in addition to the variance already explained by the perceived economic benefits. This suggests that HEI need to design a system of extrinsic rewards to foster U-I collaboration, as proposed by Awasthy et al. (2020). If, as stated above, more active collaborators are busier, their willingness to increase collaboration would depend on extrinsic rewards. Offer economic rewards, whenever possible, does make sense, given the lowest score of compensation for collaboration among the items of perceived support (see Table 2).

## 6.1 Theoretical and practical implications

Results suggest that university support has a positive impact, amplifying the perception of benefits and reducing the perception of costs. However, the results suggest that academics across the three HEI have experienced only marginal benefits from industry collaboration. This observation is particularly pronounced in the case of the Portuguese institution, where perceived costs of collaboration generally outweigh both benefits and perceived support. Remarkably, one institution (Türkiye), integrated into an industrial park, demonstrates significantly lower perceived collaboration costs, emphasizing the potential influence of convenient contact accessibility with the entrepreneurial ecosystem in which it operates. On the benefits side, economic rewards, including income prospects and research funding opportunities, emerge as the sole significant predictors of U-I collaboration behaviours.

From a theoretical point of view, our study makes a double contribution to the existing literature. Initially, the analysis incorporates academic staff who possess prior experience in collaboration as well as those who lack such experience from three different countries, meeting one of the new research lines suggested by Perkmann et al. (2021): more cross-national comparisons. The results show that the context of the HEI and the university support can influence the perception of benefits and costs and, as a result, the U-I collaboration behaviour. Therefore, comparative studies between countries or regions make it possible to understand which antecedents (individual, organisational, context) can influence collaboration behaviour more comprehensively. Also, this study presents empirical data to demonstrate that academics' personal preferences play a significant role in determining their choices regarding collaboration with industry partners. This quantitative approach, focus on social exchange perspective, distinguishes it from numerous qualitative studies by incorporating the dimension of U-I collaboration behaviour and examining the influence of academics' perceived benefits and costs on this behaviour (Bjerregaard, 2009; O'Dwyer et al., 2022) and the role of the university support in university-industry collaboration mediating by academics' perceived benefits and costs. The results made it possible to identify the academic staff's perception of the university's support and the costs and benefits related to U-I collaboration, increasing knowledge in this thematic line of the entrepreneurial university: fostering an entrepreneurial culture at the HEI, considering its internal stakeholders,

at individual and organisational level (HEI leadership) (Foss & Gibson, 2015; Urbano & Guerrero, 2013).

From a practical point of view, our research has implications both for university managers and higher education policy analysts in the adoption of adequate strategies able to promote and support the U-I collaboration behaviour. From the university managers' point of view, and with a focus on academic collaboration behaviour, the research suggests first of all the necessity: (i) to find ways to financially compensate academic staff when they are involved in collaboration with industry; (ii) to dedicate people and resources to support teachers and researchers in their collaboration endeavour; and (iii) to alleviate workloads of teachers with valuable contributions to cooperation and value it in the assessment of job performance.

Furthermore, the results of the collaboration behaviour components, showing a weak propensity of academics for spin-off creation, leads to suggest the necessity of entrepreneurial university policies, intermediary organisations (e.g., technology transfer offices, science parks, incubators) or incentives and supports that are provided by university managers can play important roles to increase the proclivity of academic staff to become founders of spin-offs.

From a higher education policy analyst's point of view, it is necessary to adjust political strategies that allow more emphasis on the entrepreneurial ecosystem as a way to collaborate (Ferreira et al., 2018). Academic entrepreneurship plays a central role in entrepreneurial ecosystems. It is necessary to develop and adjust new national higher education policies/strategies that encourage academic staff to disseminate the results of their research; they can generate knowledge spillover (e.g., creation of spin-offs, patents). In addition, we agree with Feola et al. (2021) that highlight the importance of creating an ecosystem of innovation able to promote and sustain the technology transfer processes of research from universities to the economic system, with full recognition of the role of universities as agents of this ecosystem. National and regional policies should pay more attention to the role that a regional innovation ecosystem can play in a territory's economic and social development.

## 6.2 Limitations and future research agenda

As with any other piece of work, this study is not empty of limitations, which are open for future research developments. Additional research is needed to examine the individual-level factors influencing U-I collaboration behaviour, such as gender and age. It is important to note that our study did not include an exploration of these demographic variables on the research model. The role of the university context within the flourishing literature on gender and ageing in entrepreneurship has long been overlooked (Civera & Meoli, 2023; Perkmann et al., 2021). Further research is required to gain a comprehensive understanding of the involvement of women and young academics in the behaviour and outcomes of collaborations between academia and the business sector, namely in the creation of spin-offs.

Furthermore, there is an opportunity for future work to pay more attention to the social impact of U-I collaboration; our study did not explore this dimension. This may include the implications for the design of incentives – or indeed the need to provide incentives – by universities, and considering how technology transfer offices or similar units need to be structured to enable social engagement of academic staff, not only financial (Perkmann et al., 2021).

Additionally, the U-I collaboration behaviour can be affected by university-level support beyond the costs and benefits perceived by academic staff. In this regard, additional research is required on the organisational and relational context from which U-I collaboration is conducted. We have yet to learn more about whether and how alternative structures put in place by universities, such as university-industry offices, effectively encourage university-industry collaboration.

Finally, methodologically, all of these future research suggestions may include developing more longitudinal case studies based on qualitative or narrative approaches that enable a deeper understanding of some of the U-I collaboration.

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