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Universities as innovation agents for the creative industries – An exploratory quantitative study from Wales

Komorowski Marlen [a,b,*], Fodor Máté Miklós [c]

[a] JOMEC—School of Journalism, Media and Culture, Cardiff University, 2 Central Square, Cardiff, CF10 1FS, UK
[b] Imec-VUB-SMIT (Studies on Media, Innovation and Technology), Vrije Universiteit Brussel, Pleinlaan 2, 1050, Brussels, Belgium
[c] Satbayev University - E. Turkebayev Institute for Project Management, Department of Management and Mathematical Economics, Satpaev St 22, 050000, Almaty, Kazakhstan

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ABSTRACT

Universities are increasingly recognized as key actors in regional innovation ecosystems, yet their role as "innovation agents" for the creative industries remains underexplored. While previous scholarship highlights universities' contributions through research, skills provision, and technology transfer, little empirical evidence exists on how they amplify the innovation capacity of creative firms. This article addresses this gap through an exploratory quantitative study of 385 firms in Wales, drawing on data from the *Clwstwr* programme (2019–2021), a university-led initiative. We develop an analytical framework focusing on four major innovation drivers - skills and knowledge, networking, training, and funding - and examine whether university engagement enhances their effect on firm innovativeness. Employing econometric modelling, we find that firms engaged with the university exhibit significantly stronger relationships between each driver and overall innovativeness than firms outside the university-programme. Notably, university engagement magnifies the marginal effects of networking, training, and funding on innovativeness, with funding showing particularly large gains. These results provide novel evidence that universities can act as effective innovation agents, going beyond traditional roles of knowledge creation to actively shape firm-level innovation processes in the creative industries. The findings have implications for firms, which can leverage university partnerships to strengthen innovation outcomes; for universities, which can expand their role in local creative economies; and for policymakers, who can design targeted support mechanisms to embed universities within regional innovation strategies. By situating the Welsh case within broader debates on creative clusters and university–industry collaboration, this study contributes to understanding how universities drive innovation in under-researched sectors such as the creative industries.

1. Introduction

Universities have been widely recognized as significant drivers of innovation in various sectors. Studies so far have mostly focussed on their crucial role for "technology transfer" (Héraud, 2011), e.g. creating knowledge through research and providing the necessary skills through education. Megbowon et al. (2022) for example show that higher education institutions play a key role in shaping skilled graduates who can satisfy market demands, thus bridging gaps in relevant skills for innovation. Furthermore, Musina (2023) shows that universities conduct scientific research to create new knowledge, thereby implying that they are also significant in terms of innovation.

Scholars have also examined the wider innovation roles of universities. The well-known Triple Helix model developed by Etzkowitz and Leydesdorff (2000) highlights the role of universities, alongside industry and government, in driving innovation. In this model, universities have a transformative effect on company innovation, driving firms toward research-oriented activities. Accordingly, universities are increasingly recognized for fostering innovation - for example, by facilitating collaboration (Tiwari, 2024).

We argue that universities are well positioned to enhance company innovativeness by acting as "innovation agents" within local ecosystems. In the literature, innovation agents typically refer to organizations such as accelerators, incubators and science parks that support technology

* Corresponding author. JOMEC—School of Journalism, Media and Culture, Cardiff University, 2 Central Square, Cardiff, CF10 1FS, UK.
E-mail address: komorowskim@cardiff.ac.uk (K. Marlen).

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start-ups (Evangelista et al., 2017), public agencies (Bankins et al., 2017), or even individuals like consultants assuming leading roles driving innovation (Boden & Miles, 2019). However, the broader role of universities as innovation agents has not yet received sufficient attention in the literature.

At the same time, the creative industries have gained greater importance for governments in the pursuit of innovation. For instance, it has long been acknowledged that the pursuit of 'creative cities' by local governments is driven by characteristics such as curiosity, imagination, creativity, culture, knowledge, innovation, and cooperative networks (Rodrigues & Franco, 2020). But still, because of their distinctive features, innovation processes in the creative industries remain comparatively under-researched (Komorowski et al., 2023). Such features include a large freelance workforce, a high prevalence of SMEs, and project-based work (Komorowski & Picone, 2020). This arguably means that in order to drive innovation in the creative industries, novel models are needed to best support these highly diverse businesses.

Against this backdrop, governments increasingly rely on universities to support innovation, positioning them as innovation agents across multiple sectors, including the creative industries (Roberts et al., 2025). One such example is the Creative Industries Clusters Programme (CICP) (https://creativeindustriesclusters.com/), which ran from 2018 to 2023 investing £120 million into nine research and development partnerships based around creative clusters in the UK (Department for Science, Innovation & Technology, 2023). The programme aimed to spur innovation by placing universities at the helm of each partnership. One of the CICP programmes was the Clwstwr programme (https://clwstwr.org.uk/) in Wales. Led by Cardiff University, Clwstwr offered funding, workshops, partnerships and similar forms of support.

Building on the Clwstwr programme, this article aims to contribute to the understanding of universities as agents of innovation within the creative industries through an examination of the impacts of the programme. The role of universities in cultivating innovation by governments as exemplified by the CICP programme, is recognized. Nevertheless, evidence is still lacking on how universities affect major innovation drivers and overall innovativeness, which would clarify their wider role as innovation agents. Past studies have pointed out several ways universities can support innovation but have not gone into great detail in quantifying the impacts. More broadly, this article supports the view that universities can play a dynamic role in fostering innovation that extends beyond education and knowledge creation. Accordingly, the article addresses the following research question:

How and to what extent do universities influence innovativeness in (creative industries) firms?

To answer this question, we draw on data from a survey conducted from 2019 to 2021 within the Clwstwr programme, which contains rich information on 385 firms operating in Wales' creative industries. The Clwstwr programme offers an ideal context for this study since it involves firms that have received funding, advice, networking opportunities and other support brokered by universities as well as similar firms that have not been part of the programme. Our study uses an econometric identification strategy to assess whether engagement with the universities in the Clwstwr programme enhances the marginal impact of key innovation drivers on a firm's innovativeness. More specifically, we test whether the relationships between innovation drivers and innovativeness are statistically stronger for firms that have engaged with universities when compared to firms that did not.

Quantifying the added value that universities bring to the process of innovation, this study contributes new insights into how educational institutions can effectively support the growth and sustainability of local creative clusters. In addition, understanding the mechanisms by which universities enhance innovation drivers may guide the development of more targeted strategies for fostering innovation within (creative industries) SMEs, especially for regions like Wales that heavily depend on the creative industries for economic development (Komorowski et al., 2021).

The following sections review relevant literature on the role of universities in innovation, discuss in greater detail the theoretical framework that underpin this study, and delineate the methodological approach used in analyzing the data. The findings provide empirical evidence on the amplified effects of innovation drivers supported by universities and highlight the critical role of higher education institutions as innovation agents.

2. Literature review and analysis framework

As discussed above, universities have predominantly been recognized and researched as providers of research and knowledge as well as education in supporting innovation. In this article, we argue that universities can take the role of innovation agents in a local ecosystem and thus take a much more important and central role in impacting the innovativeness of firms.

Innovation agents can be considered as those actors or organizations that introduce innovativeness in various sectors, as suggested by academic studies. The work of these agents is to bridge the gaps that exist within a firm in order to increase the diffusion of innovative practices and technologies. For example, Bessant and Rush (2019) explain how innovation agents assist organizations in assimilating new technologies in order to enhance their innovative capabilities. Similarly, Senhoras (2021) illustrates how innovation agents can promote innovation in small firms through funding. Del Fabbro et al. (2021) illustrate in their study how innovation agents assist in the development of strategic competencies to enable innovation in firms. In the literature, innovation agents are portrayed as facilitators that build key competencies or provide support to make firms more innovative. In this study, we apply this concept to universities, exploring quantitatively the potential effects that universities can have on the innovativeness of firms.

Moreover, the characteristics of innovation agents have been highlighted in studies, which place them well to play a vital role in enabling innovation. According to various research, innovation agents are appropriately placed in this role because they have an understanding of the geographical and cultural context, which is fundamental to effective innovation diffusion (Vargas-Canales et al., 2022). Other characteristics that enable innovation agents to succeed in the facilitation of innovation include human capital, experienced management, low corruption, strategic positioning within the sector, and the ability to balance relationships with private industry yet maintain autonomy (Dani et al., 2023).

In this article, we argue that universities are perfectly placed to embody these necessary characteristics. Previous research has already shown that universities work within a local context with industry, involving cognitive, social, and organizational proximity that facilitates common research interests, trust-based relationships, and effective networks (Korotka, 2015). Other key characteristics of universities include being structurally embedded in the local economy, aligned to the regional development strategies and having the ability to generate links with local stakeholders (Lebeau & Bennion, 2014). While this effective positioning of universities has been proven and researched, research lacks a detailed understanding of the impact on innovativeness of firms. Assuming universities can act as innovation agents, we need to ask what are the key drivers within a firm for innovativeness that universities can impact?

In this exploratory quantitative study, based on an extensive literature study, we identified important drivers of innovation for a firm. Literature to date identifies various drivers covering a spectrum of factors that determine a firm's ability to innovate. We have selected the following major key drivers for application in this study. It should be mentioned though, that there are various more drivers discussed and identified in literature to date. We selected the most prevalent drivers for this study to provide initial quantitative insights into the impact of universities as innovation agents (see discussion). The identified key drivers include: (1) the skills and knowledge required in a firm, (2) the

collaborations existing and reachable through networking, (3) the training available, and (4) funding available. From these critical drivers, we derived our analytical framework, which is illustrated in Fig. 1 and further elaborated in the following sections.

2.1. Skills and knowledge as innovation driver

The importance of having the appropriate skills and knowledge in a firm has, in general, been recognized as a critical factor enhancing a firm's innovativeness in various studies. Pinto et al. (2023) argued that firms with skilled employees encourage environments for creative problem-solving and effective knowledge application – important for innovation. In this context, higher levels of human capital improve a firm's capabilities in knowledge acquisition, generation, and combination, leading to increased creativity and effective transformation of knowledge into value. This subsequently leads to improvements in innovation performance (Pinto et al., 2023). By contrast, while skills and knowledge are important for innovation, firms can also struggle when such assets are not well managed. As Zmich et al. (2022) pointed out in this context: missing skills and knowledge can hinder a firm's innovativeness as employees fail to acquire external information, identify customer needs, and collaborate.

2.2. Networking as innovation driver

The importance of networking as a critical factor enhancing a firm's innovativeness has been also widely recognized in various studies. Zabel (2023) found that networking significantly enhances innovativeness in firms by establishing crucial links with suppliers, buyers, competitors, and marketing firms. Networking also enables knowledge exchange, resource sharing, and collaborative opportunities, allowing firms to leverage external expertise and insights that significantly boost their innovation capabilities. The more networked a firm is the higher innovation activity is due to greater access to diverse information and resources (Woods et al., 2019). Hilmersson and Hilmersson (2021) argue that the networking behavior of firms influences the speed of their innovation cycles, with active networking leading to quicker development of new products. Active engagement with external agents, such as market and institutional partners, has been shown to significantly enhance innovation performance (Peiró-Signes et al., 2024). Networking not only provides firms with access to external knowledge and resources but also fosters an environment conducive to innovation through collaboration and partnerships. Therefore, networking emerges as a critical driver for a firm's innovativeness, complementing internal capabilities.

2.3. Training as innovation driver

The impact of training on firm innovativeness has also been widely recognized in literature as a crucial factor that enhances a firm's ability to innovate. This is highly related to the skills and knowledge driver of innovation discussed above. Research has found that training programmes improve employees' skills, leading to increased innovation orientation and improved performance outcomes (Capelleras et al., 2021). In particular, various types of training, including managerial and problem-solving training, have been found to positively correlate with a firm's propensity to innovate (Biscione et al., 2021). Iddris et al. (2023) argue that when firms invest in training, they not only develop individual skills but also foster an organizational culture that supports innovation. This enhanced innovation capability enables firms to respond more effectively to market changes and technological advancements.

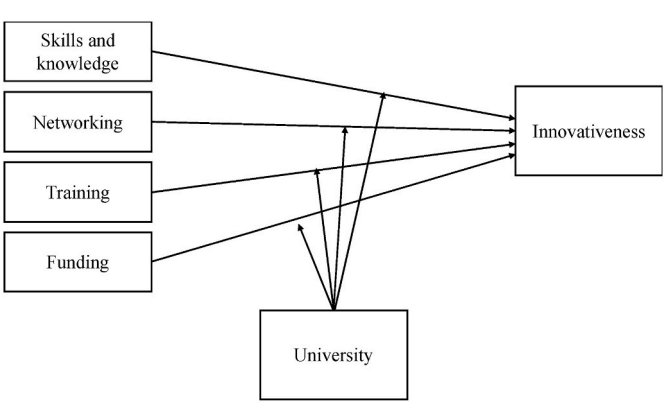

Fig. 1. Framework for analysis.

2.4. Funding as innovation drive

Funding plays a crucial role in enhancing a firm's innovativeness by providing the necessary resources for research and development (R&D) activities. Various studies have shown that access to financial resources enables firms to invest in new technologies, processes, and products, thereby stimulating innovation (Plata, 2024). This financial support can originate from various sources, including government grants, university collaborations, and public research organizations. Studies have demonstrated that government financial support enhances firm innovativeness by relaxing financial constraints, thus enabling firms to undertake more ambitious innovation projects (Yeo et al., 2022). In this context, we can see that adequate funding empowers firms to explore new ideas, develop prototypes, and bring innovative products or services to market, which might otherwise be unfeasible due to resource limitations (Peiró-Signes et al., 2024).

2.5. The role of universities

We argue in this study that the above identified and chosen key drivers of innovation can further be supported and strengthened through engagement with universities. Previous research has already pointed such a relationship out. For example, García-Vega and Vicente-Chirivella (2024) find that knowledge sourced from universities is supportive of innovation activity within firms. Balan-Budoiu and Ilies (2020) demonstrate that collaborations or networking between universities and local cultural organizations can foster innovation by creating opportunities for knowledge sharing and joint initiatives. In this context, university partnerships often yield better results than isolated initiatives because collaborative efforts combine practical industry experience with advanced academic research (Plata, 2024).

The availability and access to skills, training, funding and networking are often limited for small and medium-sized enterprises (SMEs), due to the small size of these firms. This is especially the case for creative industries firms, which frequently encounter challenges due to perceived higher risks, lack of collateral, and limited financial track records (Cunningham & Potts, 2015, pp. 387–404).

Universities can play a critical role in mitigating constraints firms like creative industries firms face. While the relationships between the above discussed drivers of innovation and innovativenss of firms is widely researched and many studies have already pointed towards the intermediating and facilitating effects of these, there has been to our knowledge no empirical studies yet to evidence this in more detail. To close this gap in research is the aim of this exploratory article.

3. Data and methodology

The aim of this article is to gather exploratory empirical evidence to evaluate the distinct influence of universities on the relationship between key innovation drivers and overall innovativeness in firms. The source of the data used in this study is the Clwstwr survey, which was collected between 2019 and 2021. It contains comprehensive

information on 385 firms active in the creative industries in Wales, primarily from the Cardiff Capital Region. While our dataset contains responses from different points in time, it is essentially a cross-section. Firms were selected for the survey based primarily on being active in the creative industries as classified by the DCMS (DCMS, 2016).

We obtained potential respondents by compiling email contacts from the FAME database, provided by Bureau van Dijk (https://login.bvdinfo.com/R1/FameNeo). For any emails that were returned as undeliverable, we updated the contact information through desk research if possible. We ensured that each firm surveyed was engaged in one of the DCMS-identified creative sectors. As responses were solicited on a voluntary basis, we acknowledge the possibility of voluntary response bias in the sample. There are no duplicate companies in the sample.

The Clwstwr survey is an ideal laboratory for our empirical experiments, because it contains data on firms that have received funding and support from the university-led programme Clwstwr. Cardiff University as well as other higher education institutions in Wales were engaged through the programme with various firms. The participants have received support, progress feedback, opportunities for networking events and workshops, all designed by academics and producers, meaning that the companies participating in the Clwstwr programme were well-versed in interacting with institutions of higher education. At the same time, the dataset also includes comparable firms active in the creative industries that were not part of the Clwstwr programme and therefore did not have significant engagement with the univerisities in the time-frame analysed. To the best of our knowledge, our dataset is unique in that it allows for a scientifically rigorous comparison of otherwise comparable firms, with the only observable difference being that a subset of them (20.77 % to be exact) engaged with universities through the Clwstwr programme.

Naturally, we acknowledge that the firms, which were part of the Clwstwr programme may be structurally different to those that had not. However, our study is not a direct comparison of observable attributes across the two groups defined by Clwstwr programme engagement. Instead, we focus on identifying the relationships between the drivers of innovation and innovativeness within firms and we examine how Clwstwr engagement influences these relationships. Through this exploratory approach, we can give first insights into answering our research question: How and to what extent do universities influence innovativeness in (creative industries) firms? An equivalent interpretation of this is that Clwstwr engagement is - in our view - a robust proxy for university engagement with the firms. It is the marginal impact of this university-led programme that we aim to uncover in the empirical relationships that shape innovativeness. The econometric identification strategy, a discussion of the treated data and the construction of our variables of interest is detailed below.

3.1. The construction of dependent and control variables

The Clwstwr survey contains information on firm's basic characteristics, such as their business turnover, their number of employees, their locations and creative subsectors of activity. These served as the control variables in our study. In addition to these readily observable characteristics, the dataset contains information on all the drivers of innovativeness that we discussed above. These include training, skills and knowledge, networking and funding. Many of these attributes are measured by subjective opinion captured on likert scales. These variables will serve as our essential explanatory variables. We present them, as well as their summary statistics after the discussion of the dependent variable, which is our innovativeness index.

There are numerous subjective and objective measures of both innovation and innovativeness in the survey data that we have used to construct an overall index of innovativeness. These components of our index measure a large range of innovative attributes, from spending on innovation, time and human resources devoted to it, to innovation outputs in terms of new products or services, as well as IP-related assets, such as copyrights and patents. As mentioned above, collecting objective measures for the main explanatory variables is not always possible due to data limitations and practical reasons that we detail below, after the calculation methodology of the innovativeness index. The innovation index is calculated from responses to the following six questions (the questions asked for the year preceding the response, i.e. 2018, 2019 or 2020):

1. Approximately how much time is your business spending in R&D activities as a percentage of total workload?
2. Approximately how much did your business invest in R&D activities?
3. To the best of your knowledge, approximately how much of your turnover (in percentages) was generated through new products or services created by your business?
4. What percentage of your employees are dedicated to R&D activities?
5. To the best of your knowledge, approximately how many Intellectual Property-related assets did your business generate in the past year, including copyrights, patents, registered trademarks and designs?
6. To the best of your knowledge, how many innovations did you or your business make in the past year?

As mentioned above, all answers to these six questions give measurable real numbers as answers, thus minimizing subjective or reference biases. The data collected is meant to reflect the best knowledge that the employee or manager had at the time of answering the survey. Blank answers were treated as zeroes, in order to maximize the amount of information that we are able to exploit for this study.

Each of the six questions (providing information for six distinct variables) was first normalized to a scale between 0 and 1. This was done by identifying the maximum observation in each variable and dividing all other observations (as well as itself) with this maximum. Then, each variable now taking a value between 0 and 1 was averaged out using an unweighted simple mean. We then added 1 to the resulting final index, in order to strictly bind it away from 0 and to allow for the possibility of running semilogarithmic regressions. We discuss this in further detail in the econometric methodology subsection. The resulting index is therefore a continuous number for each firm ranging between 1 and 2. We show the individual, untreated components' data distributions using frequency histograms in Fig. 2 below.

The resulting index is agnostic about which one of these particular variables is "the most important one" when assessing innovativeness. Depending on the exact setup of certain studies, scholars may successfully argue each one of them as being the most important. This is why we only used an unweighted simple average in this exploratory study. Also, as Fig. 3 shows, there are several highly right-skewed distributions in the individual components of the innovativeness index. Giving a higher weight to one variable or the other may have further exacerbated this skew, leaving less variation to exploit.

Moreover, the construction of the index is operationally necessary as well. Rather than running separate regressions for each indicator of innovativeness and producing 24 distinct, hard-to-interpret results, we concentrate on the combined effect of training, skills and knowledge, networking, and funding on innovativeness. Our approach examines innovativeness as a composite measure. Additionally, we explore the marginal impact that firm-university engagement has on these relationships. This approach also implies that we are essentially agnostic about which aspect of innovativeness our explanatory variables increase. This is not relevant within the context of this exploratory study. In fact, a significant influence on just one of the six components is already noteworthy on its own merit, but it is also possible that the innovation drivers effect several dimensions concomitantly. The resulting composite index and its distribution is shown below. An analytical advantage of this index over any of its components separately is that it does seem to provide a slightly less skewed and unimodal distribution, allowing us to exploit more meaningful variation for refined analysis.

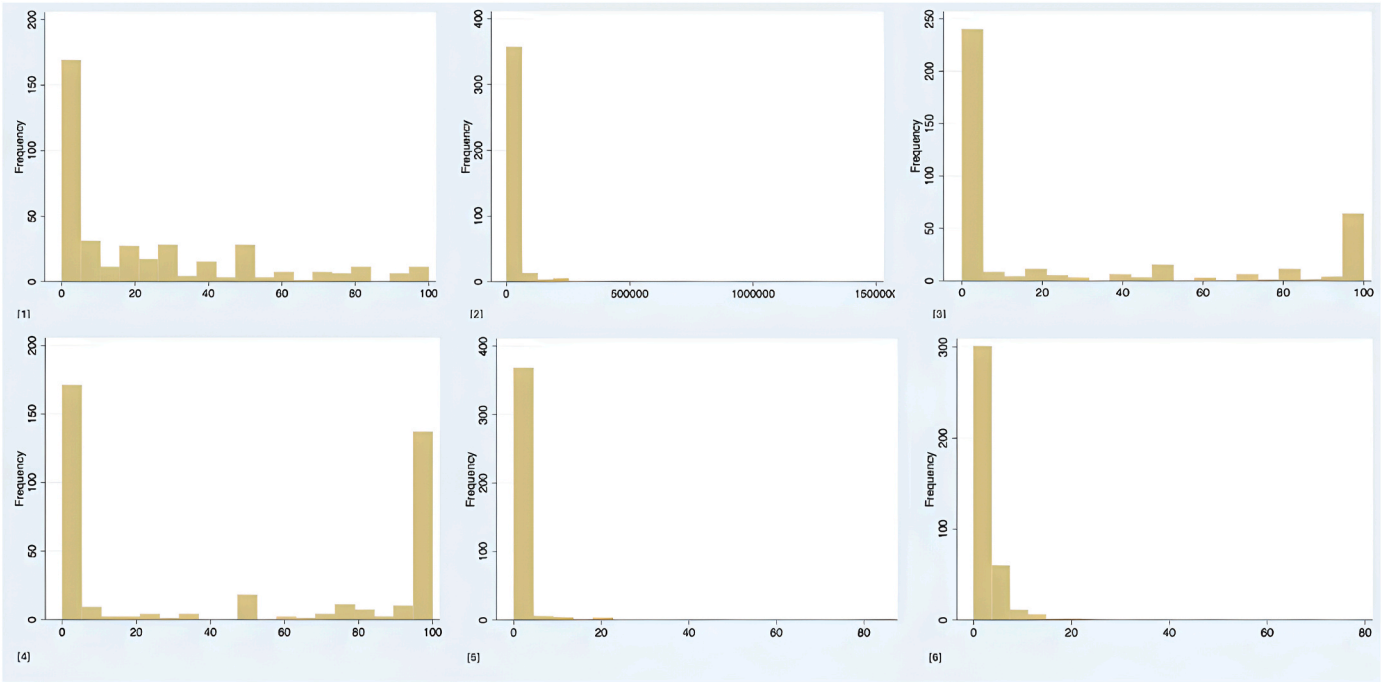

Fig. 2. The untreated distributions of the components of the innovativeness index. Note: the numbers in the squared brackets in the bottom-left corner of each panel correspond to identifying the exact variable of which the distribution is shown, as indicated by the list of survey questions and the resulting variables above.

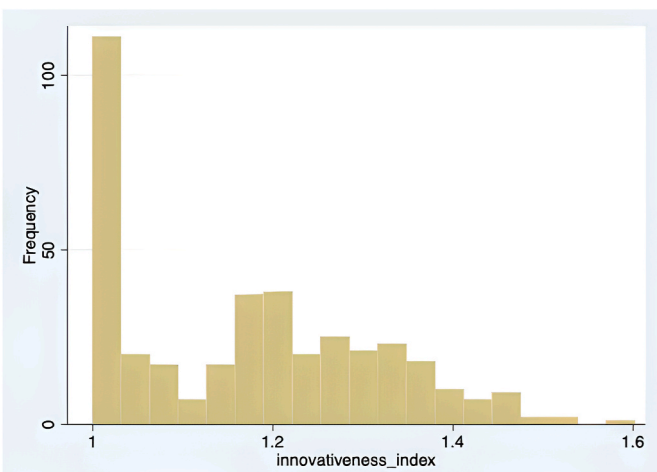

Fig. 3. The frequency distribution of the finalized innovativeness index.

In the Clwstwr survey, there are multiple ways of measuring the availability of training, skills and knowledge, networking and funding opportunities. Nevertheless, all available measures are subjective perceptions of the survey respondents. Therefore, we have focused on the particular variable for each of the four drivers that is likely to be the least plagued by subjective reference bias. This means that we focus on how respondents perceive outcomes or resource availability, rather than how they feel about the efforts that their firm exerts on accumulating innovation capacities. The fact that the explanatory variables are available on likert scales only is naturally not ideal. Nevertheless, there is a specific survey design consideration for which this was necessary. For example, while survey respondents can relatively easily collect information on various aspects of innovativeness, they cannot be expected to hold a separate internal survey about how much training or knowledge (for instance) each of their employees receive. Therefore, the subjective perceptions about the availability of innovation drivers appear to be the most conveniently measurable metrics. Naturally, this shortcoming opens the door to future studies that effectively measure more objective metrics of innovation capabilities.

The following questions resulting in answers on likert scales are used as explanatory variables. They have been chosen according to the criteria outlined above to measure training, skills and knowledge, networking and funding opportunities (the question was formulated in the following way: Please indicate if you agree to the following statements about your business: […] with likert scale responses: {1} Strongly disagree, {2} Somewhat disagree, {3} Neither agree nor disagree, {4} Somewhat agree, {5} Strongly agree):

1. Skills and knowledge: It is easy to find the right skills for business projects and activities.
2. Networking: There are lots of potential collaborators available.
3. Training: My business or business network actively supports learning and training for me.
4. Funding: Adequate funding for innovative activities is available.

As visible from these survey questions, they focus on either outcomes (such as the abundance of collaborators being the outcome of networking and circumstances) or on exogenous availability (such as the right skills and ample funding). As mentioned above, there are alternative ways to measure all of the four dimensions, but with other candidate variables, reference bias was estimated to be a greater issue than for the four chosen above. Please note that we have attributed the value "Neither agree nor disagree {3}" to the missing observations for each of the questions above, in order to maximize the information that we can exploit. In our estimation, leaving any of the questions blank is akin to giving a neutral opinion, as a strong opinion would most likely have been voiced by the respondent. The distributions of the answers on the likert scales for each of the questions above is given in Fig. 4.

3.2. *The empirical identification strategy*

What we aim to identify in this exploratory study is how a change on the answers on the likert scales change the innovativeness of a firm and

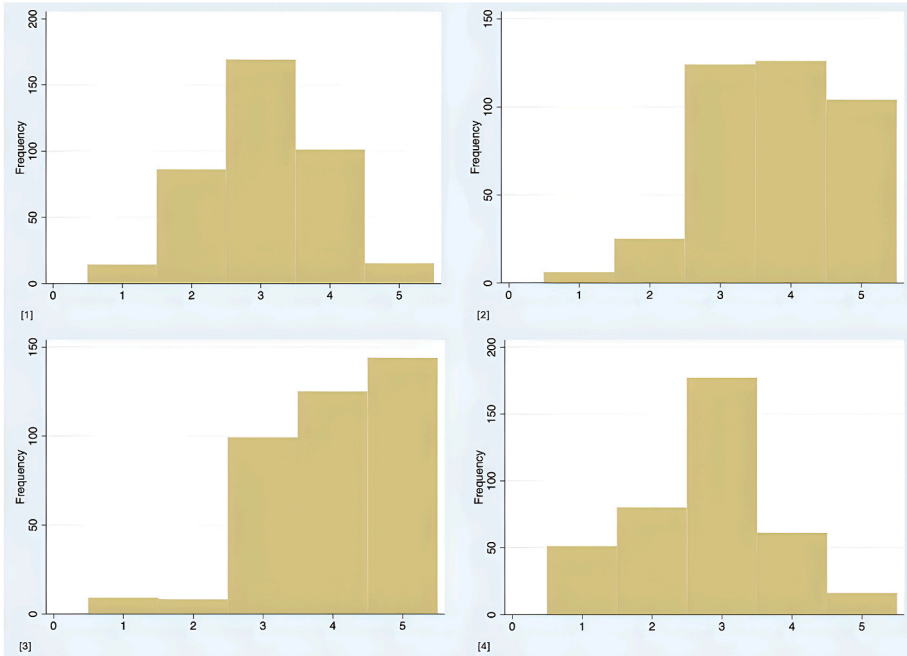

Fig. 4. Distributions of answers to the questions seeking information about innovation drivers. Note: the numbers in the squared brackets in the bottom-left corner of each panel correspond to identifying the exact variable of which the distribution is shown, as indicated by the list of survey questions and the resulting variables above. The numbers from 1 to 5 on the horizontal axis indicate the Likert-scale responses ranging from "Strongly disagree {1}" to "Strongly agree {5}".

what the effect of university engagement has on this marginal change. Our objective is to be as precise about this as possible, meaning that we aim to fix and control everything that is readily observable, such as the total number of full time employees, business turnover, location and sector of activity. We identified the empirical relationship using Ordinary Least Squares (OLS) regressions, specifically four of them (one for each innovation driver as listed above), with the innovativeness index as the dependent variable. The model that we estimate for each of the innovation drivers is the following:

$$Y_i = \alpha + \beta_1 X_{1i} + \beta_2 X_{1i}\zeta_i + \beta_3 \tau_i + \beta_4 \varepsilon_i + g\sigma + h\lambda + u_i$$

where.

Y_i is the natural logarithm of the innovativeness index for any firm i $\in \{1, 385\}$
X_{1i} is the main explanatory variable for the equation in question, as listed above (regarding skills and knowledge, networking, training and funding) for any firm i $\in \{1, 385\}$
$X_{1i}\zeta_i$ is an interaction term that takes the value of 0 if the firm has not been involved with Clwstwr and 1 if it has been, for any firm i $\in \{1, 385\}$.
τ_i is the turnover of firm i $\in \{1, 385\}$.
ε_i is the number of employees for each firm i $\in \{1, 385\}$.
σ is a sector-dependent dummy variable that identifies the sector of activity for each firm i $\in \{1, 385\}$.
λ is a locality-dependent dummy variable that identifies the geographical location of each firm i $\in \{1, 385\}$ at the city-level.
u_i is the firm-level prediction error for each firm i $\in \{1, 385\}$.
β_j with j $\in \{1, 4\}$ are the estimated regression coefficients.
g and h are vectors of estimated regressions attached to each category within both sets of dummy variables.

The main attribute of this regression methodology is that it allows us to take two firms that have the same number of employees, the same turnover and that are located in the same municipality and work in the same sector and ask: What is the percentage variation in the innovativeness index that a one-unit increase on the likert scale for any of the innovation determinants listed above gives? This is measured by β_1. Additionally, if the firm received university engagement: How does this marginal percentage variation in the innovativeness index increase, or decrease? This is measured by β_2. Our main testable hypothesis is that β_2 will be not only positive, but also statistically significant for all innovation drivers. This means that the marginal impact of increasing the perceptions around the availability of networking, skills, training and funding is relatively larger for firms who were engaged with a university than for other firms.

4. Results

We present the regression results in this section, as stipulated by the empirical identification strategy detailed above. We first focus on *Networking*. As mentioned above, the dependent variable is the natural logarithm of the innovativeness index. The regression table for this particular explanatory variable and its interaction with being involved in the university-led Clwstwr programme is given below in Table 1. It lists the estimated regression coefficients stemming from the Equation above.

As the regression output above shows, β_2 is indeed highly statistically significant and positive. This means that engaging with a university increases the effect that networking outcomes have on innovativeness. For other firms, the coefficient estimate is essentially 0, as it is a small, statistically insignificant coefficient. This means that for them, networking availability has no significant effect on innovativeness. For firms who engaged with the university programme, however, a one-unit increase on the likert scale (agreeing one-unit more that there are lots of available collaborators on the market) increases the innovativeness score by almost 1.2 %. This may not seem like a lot, but for average levels of the control variables, this means an increase of roughly 0.014 points on the innovativeness index (without taking its logarithm), which is impressive, considering that the range of the variable is only 1 (as it is set on a support from 1 to 2). Also, another interpretation of the above is that the marginal impact of enhancing networking outcomes is more than 275 % higher for firms that engaged with universities than for all others. This allows for putting the results above into perspective and

Table 1
Regression output with the explanatory variable on networking and its interaction with being a Clwstwr-involved firm. Dependent variable: natural logarithm of the innovativeness index. Note: N/A denotes no statistical significance for the estimated coefficient. * signals a statistically significant coefficient at the 10 % level, ** at the 5 % level and *** at the 1 % level (meaning the highest level of statistical significance).

Variable	Coefficient	Coefficient estimate	Standard error	Statistical significance
Lots of potential collaborators available	β_1	−0.0033	0.008	N/A
Lots of potential collaborators available x Clwstwr-involved firm	β_2	0.012	0.004	***
Business turnover	β_3	$-1.99*10^{-10}$	$2.14*10^{-9}$	N/A
The number of FTEs	β_4	−0.0001	0.0006	N/A
Sector dummies	Included	Included in the regressions but not reported here for size considerations. Full regression outputs are available upon request		
Geographical dummies	Included			
R-squared	0.26			

shows that university engagement indeed vastly increases the value that networking adds for overall innovativeness.

Next, we focus on *Skills and Knowledge*. The results from applying the Equation to this particular explanatory variable and its interaction with university-involvement is shown in Table 2 below.

Once again, just like in Table 1 above, being associated with the university increases the marginal effect of skills and knowledge considerably. While non-Clwstwr-involved firms again do not show significant innovativeness improvements as skills and knowledge increase within then, the same is not true for Clwstwr engaged firms. For them, a one-unit change on the likert scale indicating how easy it is to find the right skills increases innovativeness by 1.3 %, which, again is a significant increase, both economically and statistically speaking.

Next, we focus on *Training*. The results from applying the Equation to this particular explanatory variable and its interaction with university-involvement is shown in Table 3 below.

As shown in Table 3 above, in this instance, there is also a positive association between how much training is supported by a respondent's firm and the innovativeness index at non-Clwstwr-involved firms. It is important to mention, however, that this relationship is not statistically significant, although it is not far from statistical significance. As in Tables 1 and 2, in this instance as well, for Clwstwr-involved firms, a one-unit increase on the likert scale reflecting how much the respondent agrees with training being supported by their firm increases the innovativeness index by 1.92 % at said firm. This is a very considerable increase. Also, the marginal impact of training on the innovativeness index is 137.5 % higher for Clwstwr-involved firms than for others.

Finally, we focus on Funding. The results from applying the Equation to this particular explanatory variable and its interaction with Clwstwr-involvement is shown in Table 4 below.

The results in Table 4 are very similar to those in Table 3. Here as well, there is a positive association between how much funding is available for innovation and the innovativeness index for non-Clwstwr-involved firms. This association is comparatively small and not statistically significant. At the same time, for Clwstwr-involved firms, a one-unit increase on the likert scale reflecting the levels of available funding increases the innovativeness index by 1.78 %. This, again, is a very considerable increase. What is especially remarkable here is that the marginal impact of funding on the innovativeness index is 2866 % higher for Clwstwr-involved firms than for others.

5. Discussion of the results and recommendations

This exploratory study assessed how universities, acting as innovation agents, influence the relationship between four main innovation drivers - networking, skills and knowledge, training, and funding - and the overall innovativeness of creative firms in Wales. Drawing on survey data from the Clwstwr programme, which covers both firms that joined the university-led initiative and those that did not, we present the first empirical evidence that universities can serve as effective innovation

Table 2
Regression output with the explanatory variable on skills and knowledge and its interaction with being a Clwstwr-involved firm. Dependent variable: natural logarithm of the innovativeness index. Note: N/A denotes no statistical significance for the estimated coefficient. * signals a statistically significant coefficient at the 10 % level, ** at the 5 % level and *** at the 1 % level (meaning the highest level of statistical significance).

Variable	Coefficient	Coefficient estimate	Standard error	Statistical significance
Skills easy to find	β_1	−0.0012	0.007	N/A
Skills easy to find x Clwstwr-involved firm	β_2	0.013	0.005	***
Business turnover	β_3	$-3.24*10^{-10}$	$2.15*10^{-9}$	N/A
The number of FTEs	β_4	−0.00004	0.0006	N/A
Sector dummies	Included	Included in the regressions but not reported here for size considerations. Full regression outputs are available upon request		
Geographical dummies	Included			
R-squared	0.26			

Table 3
Regression output with the explanatory variable on training and its interaction with being a Clwstwr-involved firm. Dependent variable: natural logarithm of the innovativeness index. Note: N/A denotes no statistical significance for the estimated coefficient. * signals a statistically significant coefficient at the 10 % level, ** at the 5 % level and *** at the 1 % level (meaning the highest level of statistical significance).

Variable	Coefficient	Coefficient estimate	Standard error	Statistical significance
Training supported	β_1	0.008	0.006	N/A
Training supported x Clwstwr-involved firm	β_2	0.011	0.003	***
Business turnover	β_3	$-3.64*10^{-10}$	$2.14*10^{-9}$	N/A
The number of FTEs	β_4	−0.0001	0.0006	N/A
Sector dummies	Included	Included in the regressions but not reported here for size considerations. Full regression outputs are available upon request		
Geographical dummies	Included			
R-squared	0.28			

Table 4
Regression output from running Equation (1) with the explanatory variable on funding and its interaction with being a Clwstwr-involved firm. Dependent variable: natural logarithm of the innovativeness index. Note: N/A denotes no statistical significance for the estimated coefficient. * signals a statistically significant coefficient at the 10 % level, ** at the 5 % level and *** at the 1 % level (meaning the highest level of statistical significance).

Variable	Coefficient	Coefficient estimate	Standard error	Statistical significance
Training supported	β_1	0.0006	0.007	N/A
Training supported x Clwstwr-involved firm	β_2	0.017	0.005	***
Business turnover	β_3	$-1.35*10^{-10}$	$2.12*10^{-9}$	N/A
The number of FTEs	β_4	−0.0001	0.0006	N/A
Sector dummies	Included	Included in the regressions but not reported here for size considerations. Full regression outputs are available upon request		
Geographical dummies	Included			
R-squared	0.28			

agents. Firms involved in Clwstwr exhibit far stronger links between every innovation driver and their overall innovativeness than non-participants. In every regression model, the interaction between each driver and Clwstwr participation is positive and statistically significant at the 1 % level, confirming a robust university effect.

Regarding specific drivers, a one-point increase on the Likert scale for networking availability raises the innovativeness index of Clwstwr firms by roughly 1.2 %, with a marginal effect more than 275 % larger than for non-Clwstwr firms, where networking shows no significant impact. A similar one-point gain in perceived access to skills and knowledge increases innovativeness by about 1.3 % for Clwstwr participants, again demonstrating a markedly stronger effect than in firms outside the programme. Enhanced training support produces an almost 1.92 % rise in the innovativeness index for each scale point for Clwstwr firms, a marginal effect 137.5 % higher than in non-participants; in concrete terms, a one-point increase raises innovativeness by nearly 1.78 % for those in the programme. Funding availability shows the most dramatic difference: its marginal effect on innovativeness is 2866 % greater for Clwstwr firms, whereas it is positive but not statistically significant for non-participants.

Control variables - business turnover and the number of full-time employees - never reach significance and adding sectoral and geographic dummies does not alter the results. These checks confirm that the amplified relationships stem from university engagement rather than firm size, industry, or location effects, strengthening the overall robustness of our findings.

These findings highlight the nuanced role that Welsh universities play as innovation agents in the creative economy. They act as bridges between creative practitioners and policy-driven economic development goals, fostering local networks and translating global creative trends into regional opportunities. Notably, the "creative industries" have only been formally recognized as part of UK industrial policy since the late 1990s (DCMS, 1998), making this a relatively recent policy framing. This contemporary framing has both enabled and constrained the sector. For example, some scholars welcomed the integration of culture into economic strategy - O'Connor (2016) observes that arts and culture have benefitted from their co-option into public policy agendas - while others are more critical, with David Hesmondhalgh arguing that the very term "creative industries" signals an accommodation with neoliberal values at the expense of critical cultural analysis (Hesmondhalgh, 2008). These divergent viewpoints underline that the creative industries paradigm, even as it underpins our study, is contested terrain. Importantly, our research situates Welsh creative-university partnerships within this broader UK context. Universities have been incentivized to drive innovation and regional growth through culture – a trend exemplified by major initiatives (Roberts et al., 2025). The UKRI's Creative Industries Clusters Programme, being part of this Industrial Strategy, epitomizes the economically focused agenda of recent years by funding university-industry partnerships to "drive innovation and growth" in creative hubs (Oakley & Ward, 2018). In Wales, universities leveraged such agendas to secure support for creative clusters and spearhead projects in digital media, design, and the arts. At the same time, we remain cognizant of potential downsides. Critics note a tension in universities' expanded role: by heavily emphasizing economic utility, universities may inadvertently perpetuate an instrumental view of culture, sidelining their traditional function of cultural critique (Moreton, 2018). Our conclusion therefore not only celebrates the entrepreneurial, network-building achievements of Welsh universities in the creative industries but also reflects on this balance between economic impact and critical cultural stewardship. Finally, these insights connect back to the literature on creative clusters and creative cities (Rodrigues & Franco, 2020). The Welsh case shows how place-based creative ecosystems can thrive with universities as anchor institutions – a dynamic consistent with established cluster theory. As Pratt's work on creative clusters suggests, understanding such ecosystems requires looking beyond simple co-location of firms to the specific cultural, social and regulatory contexts that shape creative production (Pratt, 2004). In line with this, our study found that universities contribute far more than just research and development outputs; they nurture creative communities, curate knowledge exchange, and help configure supportive policy environments. Grounding these findings in the discourse of creative clusters (Pratt, 2004) underscores their broader relevance. By contextualizing the Welsh experience within national policy developments and scholarly critiques, we provide a conclusion that acknowledges both the promise and the complexity of positioning universities as innovation agents in the creative industries.

This finding underscores the critical role of universities as innovation agents, showing that they can foster firm innovativeness through multiple drivers. University engagement amplifies the effectiveness of these drivers, indicating that institutions do more than merely supply resources and support; they also create an environment in which firms can better leverage networking, skills, training, and funding. When universities operate as innovation agents through programmes like Clwstwr in Wales's creative industries, they appear to expand networking opportunities, improve access to skills and knowledge, strengthen training support, and make funding more impactful.

The implications are significant for firms, universities, and policymakers. (1) First, our evidence suggests that firms can increase returns on investments in innovation drivers through university partnerships; firms should therefore collaborate proactively with universities to translate innovation potential into market competitiveness. (2) Second, for universities, active industry engagement enhances their role as innovation agents, advancing both innovation and economic development. (3) Third, policymakers can encourage university–industry collaboration as an effective strategy to strengthen innovation within the creative industries and stimulate regional growth. This requires policies and resources that promote such partnerships and give universities leading roles in programmes designed to support innovation. Continued development of, and participation in, initiatives like Clwstwr should be encouraged, as universities can effectively support the creative industries through them.

While this study provides valuable insights into universities' role as innovation agents, several avenues merit further exploration. Longitudinal data could clarify the longer-term effects of university engagement on firm innovativeness and test the durability of the reported findings. Combining quantitative analysis with qualitative methods—such as interviews and case studies—would offer deeper insight into how university partnerships enhance innovation drivers by revealing nuanced firm–university interactions. Additional innovation drivers should be examined to build a more detailed picture of how universities act as innovation agents.

Future research could extend beyond the creative industries to assess whether the amplifying effect of universities is sector-specific or consistent across other economic sectors. Studies investigating which elements of university programmes most effectively enhance innovativeness would help optimize such initiatives. Examining firm-specific factors - such as organizational culture, leadership, and absorptive capacity - in conjunction with university partnerships would provide a more holistic view of the determinants of innovativeness. Research on how different policy environments shape the effectiveness of university–industry collaborations could inform the design of supportive regulatory frameworks.

In conclusion, this article demonstrates exploratively the central role universities can play as innovation agents in local creative clusters. Contributing to a broader understanding of innovation ecosystems, the study provides quantitative evidence that university engagement significantly reinforces the positive effects of core innovation drivers on firm innovativeness. These findings indicate that universities, through programmes such as Clwstwr, not only deliver direct support to firms but also enhance the effectiveness of firms' own innovation activities. Encouraging and investing in university - industry collaboration thus emerges as critical strategies for fostering innovation and economic

development within the creative industries. Stakeholders at all levels - firms, universities, and policymakers - should recognize and capitalize on this collaborative potential to drive innovation and sustain growth in an increasingly competitive and dynamic economic landscape.

CRediT authorship contribution statement

Komorowski Marlen: Writing – review & editing, Writing – original draft, Validation, Supervision, Project administration, Methodology, Funding acquisition, Data curation, Conceptualization. **Fodor Máté Miklós:** Visualization, Methodology, Formal analysis, Data curation.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used ChatGPTo1 and typeset.io for the literature review and writing process including structuring and reasoning of the text. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Marlen Komorowski reports financial support was provided by Arts & Humanities Research Council (UK) and UK Research & Innovation. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data availability

Data will be made available on request.

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