Analysing Higher Educational Institutions' role in fulfilling their Third Mission

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Abstract. The transitional process happening in higher educational institutions tend to underscore initiatives aimed at positioning these institutions as hubs of knowledge production and transfers capable of influencing regional development. Nonetheless, the literature has failed to capture the extent to which these institutions have embraced their third mission of impacting regional development, thus calling for a broader range of approaches in examining the roles of these institutions. To fill this gap, this study evaluates the various ways higher educational institutions have embraced their third mission of contributing to the development management activities of regions. We sourced data from 164 higher education institutions (HEIs) located across the United Kingdom, employing the propensity score matching estimation model to estimate the average treatment effects (ATE) of various interventions. The results demonstrate additionality effects of HEIs on graduate support, attracting inward investment, R&D collaborations and network facilitation. Surprisingly, our results show HEIs as playing an insignificant role in supporting SMEs, and knowledge exchanges. The main implication of this is that adopting initiatives that proved successful in specific universities to other higher educational settings remains a challenge.

Key words: Propensity scores matching, regional development, higher education institutions, knowledge transfers, third mission, United Kingdom

1 Introduction

Interest in research exploring the contributions of higher education institutions (HEIs) to economic growth, regional development, and as agents of social change has soared in recent decades (Kempton 2019). This new role of HEIs in driving regional growth and development denotes an embracing of the novel third mission alongside the traditional (pedagogical) and second (research) duties (Sánchez-Barrioluengo, Benneworth 2019). Higher educational institutions (universities and public research laboratories) have long played central roles in national and regional innovation systems (Carayannis et al. 2018, Asheim 2019). They have also been pivotal in knowledge production and dissemination (Fischer et al. 2019). Traditionally, HEIs have contributed to regional and national economies by new knowledge production through basic applied research (Sengupta, Ray 2017), while contributing to the overall workforce by educating new generations of scientists (Trippl et al. 2015).

In recent times policy makers expect universities to move beyond the supply of human capital, to playing an active role in regional development (Nicolescu 2018). The role of universities in the regional economy has been reinforced by the triple helix framework (Frondizi et al. 2019). This has supported and exemplified the conviction that the research capabilities of regional institutions such as universities can be leveraged to contribute to regional development (Rodríguez-Pose 2013). Regional development refers to concerted efforts undertaken by policy makers to develop certain parts of a country socioeconomically. Regional development is therefore not just assessed by the number of jobs created or incomes, but other general subcomponents such as creativity and innovation in the region (Bærenholdt 2009, Pike et al. 2016). Regional institutions like universities can be the main drivers of such creativity and innovation. Regional development must not be confused with territorial development which is a subset term used to refer to a cohesive multi-sector development limited to a specific part of a territory that relies on the expertise of regional institutions like universities (Bran et al. 2018). This enhanced and deeper role of universities in regional development is strongly reflected in recent strategies and policies at the European level such as Europe 2020 and flagship initiatives like the innovation union. Although universities have long been important actors in regional innovation systems, implementation of the smart specialization policy has amplified and entrenched this role (Carayannis et al. 2018).

Smart specialization affords universities new opportunities to intensify and expand their contributions to regional development and innovations (McCann, Ortega-Argilés 2015). It puts universities at the core of their regions, with an expectation to forge new collaborations with local and regional authorities, industries, and civil society for win-win benefits (Kempton 2015). According to Foray et al. (2012), "universities have a crucial role to play in creating knowledge and translating it into innovative products and services, in cooperation with research centers and businesses. Successful mobilization of the resources of universities can have a strong and positive effect on the achievement of comprehensive regional strategies".

According to Gunasekara (2006), universities can play two central roles to enhance regional and territorial development. A generative role relates to the direct promotion of growth opportunities through knowledge capitalization and entrepreneurial discovery activities such as the formation of spin-offs, and active participation on industrial boards. They can in tandem evaluate pitfalls in regional innovation environments and take the initiative in organizing networks for the development of regional innovation strategies. In addition, universities can influence regional institutions and the advancement of social capacity through fostering regional collaborations and institutional capacity building, in-house training activities as well as mediating between regional, national, and international actors (Gunasekara 2006).

Similarly, Kempton et al. (2013) have proposed seven possible areas through which universities can engage in regional development and smart specialization strategy. First, they can help to outline regional strategies by carrying out a thorough assessment of the region's capabilities, knowledge assets and competencies. Secondly, through academic research, universities contribute to the local knowledge base and its subsequent transformation into innovative products and services. Additionally, they can weigh into the regional entrepreneurial unearthing process through global awareness and collaborations across regional boundaries. Universities can in addition aid in fostering the social relations that underpin regional innovation systems, and lastly, they can contribute to regional institutional leadership and smart specialization governance.

Furthermore, universities can provide professional research expertise that can bridge national and international knowledge networks. Universities can also contribute to regional development through demand-side knowledge transfer and absorptive capacity development through new business formation (spin offs), graduate start-ups and graduate placements, all of which are aimed at boosting numbers of active collaborators with local industries. The potential incapsulated in a region's innovative activities are based on two main capacities: the ability to entice good ideas or information from elsewhere (absorptive capacity) and the ability to utilize absorbed knowledge to generate and develop new products or services (development capacity). Universities also contribute to the supply of

regional human capital through teaching programs such as lifelong learning and graduate and post graduate courses (Kempton et al. 2013).

Considerable attention has been given to the concept of socially engaged universities (including other higher educational establishments) in recent years (Klofsten et al. 2019). The literature contends that academic engagement and contributions to regional growth and development in the United Kingdom and the USA has increased over time (Degl'Innocenti et al. 2019). Yet fewer studies have been devoted to understanding the various ways higher educational institutions contribute to socioeconomic development or the social impact they have on their respective regions. Some caveats remain, however, in understanding which aspects of socioeconomic and regional development universities and other higher educational institutions are making impacts. The primary aim of this study is to assess the various ways universities and other higher educational institutions in the United Kingdom contribute to fulfilling their third mission of promoting regional development. This study intends to deepen the understanding of the experience of the United Kingdom's higher educational institutions' academic engagement in regional development in a hypothesis-based study. This study contributes to and fulfils the theories of knowledge transfers and regional development. These theories assume that academic knowledge and technologies can be transferred within regional actors (networks) to boost regional innovations, capacities, and development.

This article is arranged as follows; the following section (Section 2) focuses on the theoretical and empirical literature exploring the relationships between higher educational institutions' contributions to regional development. The third Section elaborates on the empirical methodology, the source of data and the variables employed in the model. Section 4 is devoted to reporting the findings of the econometric model specifications. Section 5 provides an in-depth discussion of the results in relation to existing literature. Section 6 concludes this paper with implications and suggestions for future research.

2   Theoretical background

This research is based on the triple helix theory that presupposes that universities are no longer just in the business of producing graduates and industry-worthy personnel each year, but also actively engaged in the creation, sharing, dissemination and application of knowledge for the purposes of regional growth, and eventually, development. This theoretical framework is strongly reliant on the perception that universities are not just thinkers but applicants and users of knowledge creation from interactions with other stakeholders and even employees themselves (Amin, Goddard 2018). The triple helix model places emphasis on the proactive roles played by regional actors like higher educational institutions in the knowledge society (Ranga, Etzkowitz 2013).

The academic environment has undergone disparate structural revolutions that have overhauled the roles of higher educational institutions in the economy. The first academic revolution can be traced to the 1930s (Schmitz et al. 2017), and is known for the tendency of universities to conduct research alongside the conventional mission of teaching (Etzkowitz, Dzisah 2015), however this did not encourage academic collaborations and engagements. The second and third academic revolutions that took place in the 1980s (Clark 2015) transformed and paved way for the direct engagement of universities in the economy. This led to the emergence of entrepreneurial scientists and universities (Altbach et al. 2019). HEIs have contributed to economies through novel knowledge production via their basic applied research. Recently, policy makers demand universities move beyond knowledge production, to playing active roles in regional development with their research capabilities (Nicolescu 2018).

Traditionally, universities have been known as 'hubs' of intrinsic and theoretical knowledge, endowing students with limitless potential. Furthermore, with such inherent potential, consistent interaction and knowledge sharing consciously creates cognitive thoughts and ideas that actively morphs into practical knowledge for use by these universities. Research on knowledge sharing in 230 United Kingdom universities shows that these universities possess an intrinsic knowledge culture, but their culture is self-centered and to some extent self-serving (Fullwood et al. 2019), presenting knowledge

management challenges. However, universities could fail in achieving their objective of knowledge exchange for a myriad of reasons. For example, firms in the region may not be endowed with the resources needed to absorb the knowledge on offer (Qiu et al. 2017). In addition, universities that try to foster a transfer of knowledge, may also have difficulties impacting their own regional economies (Youtie, Shapira 2008), likely due to resource limitations or outright performance inefficiency. Nevertheless, we believe that, when maximized, knowledge exchange can help to facilitate the development management initiatives of both higher educational institutions and their regions. Hence, we hypothesize that:

H1: Knowledge exchange has a significant positive impact on development management activities of higher educational institution in the region.

Furthermore, closely related to their most prominent role of producing graduates, universities are also known for providing material and immaterial support for their graduates in the form of financial awards and even start up support. Most research underscores the role higher education institutions play in determining the possibilities of individual graduates being self-employed or creating their ventures (Honig 2004). A growing body of policy evidence suggests a positive association between the extent of a cohort's entrepreneurialism and the performance of regional and national economies as the number of HEIs using their initiatives to stimulate graduate enterprise and entrepreneurship increases (Fischer et al. 2019, Marzocchi et al. 2019). We believe that the organizational capabilities and resources of a university, and the knowledge generated through research affect the entrepreneurial competences of graduate entrepreneurs, and influence the capacity of universities to generate student ventures and assist with social development of the region. This is widely supported by the literature (Marzocchi et al. 2019, Anderson, Stejskal 2019). In this regard we hypothesize that:

H2: Graduate support is significantly and positively influential to development management activities of higher educational institutions in the regions.

Furthermore, inputs aside, investment inflows have been shown to be directly connected to an improvement in human development and regional research output performance. A stream of investors can commit funds in support of universities' research and development agendas (Reiter, Steensma 2010). University-industry linkages, their reputational strength, and technology clusters appear to be key factors in attracting investment from foreign nationals, though Teirlinck, Spithoven (2012) may have found the contrary. Most authors believe investments do not run a sequential route to ensuring development in the regions. This is due to various barriers such as political structures, administrative capacity and the inefficiency of these investments that could easily hinder their transmission into proper social interventions and development of the region concerned. Nevertheless, we believe a consistent stream of funds coupled with proper allocation will facilitate value creation for established ventures (Rodríguez-Pose, Fratesi 2004, Mohl, Hagen 2010) and essentially assist development management activities in the regions. Hence, we also hypothesize that:

H3: Inward investment has a significant and positive impact on development management activities of higher educational institutions in the region.

Research and development collaborations have also largely been discussed by most researchers as having a significant impact on educational institutions (Aldieri et al. 2018, Bischoff et al. 2018). Nosenko et al. (2018) researched such collaborations in the context of the cloud-based society. The study found the use of cloud-based resources needs to be more systematic, to be organized into a united system, and to be consciously and purposely oriented at pedagogical aims. They opined that there is a current need for the upgrading of ICT skills of educational personnel, especially those engaged in providing educational systems with emerging ICT. Considering the broad engagement of academic researchers in collaboration with other research institutions, we believe that the reputational enhancement of their institutions and an extension of these institutions' capacity for knowledge transmission should help develop the regional development activities of academic institutions (Klofsten et al. 2019). Hence, we hypothesize that:

H4: Research and development collaborations positively and significantly influence development management activities of higher educational institutions in the regions.

Furthermore, according to the endogenous theory, human capital forms a central element of the growth theory and can be described as an enabling factor of innovation (Gomez 2011). As imperative as personnel is to the growth of productivity, it is crucial to acquire the right fit for the needed roles (Moreland 2013, Pather 2014). In this context, we presuppose that efforts of educational institutions to fulfill these needs will create a deepened effort to recreate and innovatively shape the learning structure of higher institutions. Additionally, by developing institutional collaboration opportunities like contests, scientific hubs, and international networks, we believe this will further strengthen the talent and skill growth of these higher educational institutions. Hence, we hypothesise that:

H5: Higher education institutions facilitated networks can positively and significantly impact the development management of regions.

3 Data and Methodological approach

The empirical analysis is based on a cross-sectional dataset from the Higher Education Business and Community Interaction Survey (HE-BCI). The HE-BCI Survey is obligatory for all higher education providers in the United Kingdom (Wales, Scotland, Northern Ireland and England). The HE-BCI Survey collects data for evaluating the volume and direction of collaborations between UK higher education providers and industries and the general community (Marzocchi et al. 2019). The survey collects information on the third mission of higher educational institutions by investigating the various ways they contribute to their regional economies. The survey also provides data on capacities and strategies of HE providers, and financial data on their third-stream activities related to the usage, production, application and utilization of knowledge and other HE provider capabilities outside academic environments. The survey consists of two parts, the first part requires HEI to answer and provide information related to their engagement strategies and competences and their ability to work with other organizations. The second part pertains to HEIs activities in areas such as contract (collaborative) research, their engagements and services to businesses and communities, development and regeneration plans, intellectual property, and other cultural and social engagements with communities. We used datasets spanning four academic years, specifically the 2014/15 academic year to the 2018/19 academic year. The final sample used for the empirical model specification consisted of all the 164 higher educational institutions that filled and return these questions in the time period.

For the model specification, this paper involved a two-stage analysis. In the first stage, we employed a binary logistic regression to estimate the probability of a binary outcome based on one or more covariates (Archer, Lemeshow 2006). The binary logistic regression model applies the techniques of multiple regression analyses to research situations in which the outcome variable is categorical (Sperandei 2014). We used the logit regression model and cross-sectional data to examine variations in the university's development contributions based on the changes in the predictor variables. The model assumes that the dependent variable is a linear function of the independent variables and the logit transformation of the dependent variable having an error term that is not normally distributed and denoted by (ϵ_i). We analyze the probability that universities would contribute to their regions through several ways, and we assume that these associations are not a linear function and hence, we the assumed the relationship mathematically as

$$\text{Logit}(P) = \log(P/1 - P) = \log(p) - \log(1 - P) \tag{1}$$

Where:

Logit (P) = the logit (log of the odds ratio)

P = The probability of implementing development activities

1-P = the probability of not implementing development activities

We provide the reduced form of the Logit model equation as,

$$\mathrm{DM}_i = \alpha + \beta_i X_i + \epsilon_i \qquad (2)$$

Where:

DMi$_i$ = Higher educational institution' Development Management activities

$\boldsymbol{\alpha}$ = intercept

$\boldsymbol{\beta}_i$ = slope coefficient of each of the explanatory variables

$\boldsymbol{X}_i$ = Coefficients of the covariates

$\boldsymbol{\epsilon}_i$ = The error term

In the second stage, we use the propensity score matching technique to examine the additionality effect of the social impacts of universities engagements. The propensity score matching technique is used to estimate the average treatment effects of an activity, policy, treatment and other interventions, by reporting the covariates that envisage receiving the treatment (Abadie, Imbens 2016). We modelled the outcome variable as development management, and the treatment dependent variables as the various ways universities contribute to social development. This approach helped us to control and eliminate all potential confounding factors (Diamond, Sekhon 2013).

Table 1: Description statistics of the dependent and independent variables

Variable	Variable description	Mean	VIF
Knowledge exchange	1 if HEIs share knowledge with regional partners, 0 otherwise	0.931	1.12
SMEs support	1if HEIs provides facilities, equipment, consultancy, services to SMEs, 0 otherwise	0.879	1.56
Graduate support	1 if HEIs support graduate entrepreneurship, 0 otherwise	0.881	1.10
Incubator support	1 if HEIs provide services to start-ups to improve their commercial success, 0 otherwise	0.700	1.46
Attracting investment	1 if the HEIs bring investment to the region, 0 otherwise	0.628	1.25
R&D collaborations	1 if the HEIs engage in R&D collaborations with other regional bodies, 0 otherwise	0.817	1.12
Attracting nonlocals	1 if HEIs attract nonlocal population, 0 otherwise	0.804	1.14
Regional development	1 if HEI help their regions affected by socioeconomic and environmental decline to rebuild, 0 otherwise	0.743	1.21
Managing development	1 if HEI manage any wealth creation and social development activities, 0 otherwise	0.665	—
Facilitating networks	1 if HEI promote networking activities, 0 otherwise	0.798	1.24
Meeting reg. skills	1 if HEI knowledge contribute to skills development challenges, 0 otherwise	0.847	1.30

Source: Authors' calculations, *Note*: VIF = Variance Inflation Factor

4   Results

Before commencing with the results and discussion, it is pertinent to briefly discuss the descriptive statistics and correlation of variables used in the empirical model. The results

Table 2: Results of Wald test of exogeneity

Variables	Coefficients	Standard error	$P > |z|$
Incubator support	1.133	0.792	0.152
Meeting reg. skills	0.323	0.222	0.147
Knowledge exchange	1.157	0.437	0.008**
SMEs support	-0.236	0.443	0.595
Graduate support	0.997	0.292	0.001***
Attracting investment	0.744	0.252	0.003***
Constant	-2.826	0.473	0.000***
Model summary			
N		164	
Wald chi^2		129.28	
Prob >chi^2		0.000***	
Endogenous variable		Incubator support	
Instruments		All variables not found in	
		this model were instrumented	

Source: Own calculation. $*** = p < .001$, $** = p < .01$, $* = p < .005$.

Wald test of exogeneity: chi^2 = 3.23, prob > chi^2: 0.0722

of the Variance Inflation Factor (VIF) in Table 1 show that the correlations between the dependent and explanatory variables are low, hence the sample does not suffer from potential collinearity issues. The mean results of the descriptive statistics in Table 1 show that universities in the United Kingdom play key roles in contributing to regional development management. The results suggest the presence of relatively high levels of academic engagement activities across United Kingdom universities and other higher educational institutions. The degree of knowledge exchange among these institutions was strongly noticeable in the sample. About 93% reported to have exchanged knowledge in diverse forms with other regional actors. Support for SMEs is also relatively high, with the average value for this variable at 88%. Beside their contributions to knowledge creation and dissemination, they also attracted inward investment to their regions, with 63% of the sampled population contributing in this regard. The presence of these higher educational institutions also helped to attract non-local residents potentially resulting in a trickle-down effect on regional development. Institutional collaborations are also very high among the sample population (82%). These collaborations could result in innovations that could spur regional development and management. Approximately 70% of the higher educational institutions have incubator support systems with funding to acquire new skills and expertise to help start-ups to succeed in regions or international markets.

The figures also show that about 85% of these higher educational institutions meet the regional skill needs of their catchment areas. With regards to facilitating networks, about 80% of the sampled higher educational institutions reported carrying out these activities. On the question of having strategies in place that promote the management of regional development by these institutions, 66% of institutions declared that they have strategies in place that contribute to the development management of their regions. About 80% of these higher educational institutions also declared that they attracted residents who are non-locals to these regions who could be either students, faculty or other workers. The community development agenda was also very prominent among higher educational institutions in the United Kingdom, about 74% of the sample reported that they contributed directly or indirectly in this regard.

The econometric model estimation aims to describe the expected effects of the predictors on the dependent variable, as shown in Table 3. As noted previously, we believe that higher educational institutions having regional development strategies will strengthen their incubator related activities and help to alleviate regional skill deficits. We anticipate that this could result in a reverse causality problem with potentially negative

Table 3: Results of the logit regression analysis

Variables	Coef.	Std. Err	z	$P > z$	Hypotheses
Facilitating networks	1.116	0.387	2.88	0.004**	*H5*-Supported
Graduate support	1.604	0.491	3.26	0.001***	*H2*-Supported
Inward investments attracting	1.165	0.272	4.28	0.000***	*H3*-Supported
R&D collaborations	1.461	0.292	5.00	0.000***	*H4*-Supported
Attracting nonlocal students	0.592	0.298	1.98	0.047*	*H1*-Supported
Regional development	1.501	0.263	5.70	0.000***	
Meeting regional skill needs	0.248	0.375	0.66	0.508	
Incubator support	0.453	0.316	1.43	0.151	
Knowledge exchange	0.805	0.718	1.12	0.262	
Supporting SMEs	0.209	0.501	0.42	0.677	
Model fit statistics					
Number of obs.			164		
Log pseudolikelihood			-232.13854		
Wald chi^2(10)			205.05		
Prob > chi^2			0.0000***		
McFadden Pseudo R^2			0.4433		

Source: Own calculations.

Note: *** Parameter significant at 99 % level, ** significant at 95 % level, * significant at 90 % level.

impact on our results. We therefore tested further which of the variables considered endogenous can be tested for exogeneity. The Wald test of exogeneity considers whether the null hypothesis of exogeneity is confirmed by our data (see Monfardini, Radice 2008). We ran an instrumental Variable (IV) probit model using Newey's two-step estimation to test for potential endogeneity in our data. We used the provision of incubator support activities of these higher educational institutions as an endogenous variable and the existence of development management strategies as the dependent variable. All the remaining variables were instrumented. The Wald test results show that Chi^2 (3.23), Prob > Chi^2 = 0.072. (see results in Table 2). The result is insignificant at the 95% confidence interval; ergo, we accept the null hypothesis. Hence, our variables are not contaminated with any potential endogeneity problems. The results show that there is no need for instrumental variable model estimations because the estimates of the binary logistic model are efficient and consistent.

An initial assessment of the logit model in Table 3 suggests that the predictive power is 44% as per the value of the McFadden Pseudo R^2 statistics. The results show that six of the variables demonstrated to have a positive and statistically significant relationships. The results show that there is a positive and statistically significant relationship between graduate support and higher educational institutions development management ($\beta = 1.604$, $p < 0.001$). This supports hypothesis *H2*. This signifies that higher educational institutions likely contribute to supporting graduates in diverse ways.

Furthermore, the relationship in hypothesis *H3* is also supported. We found a positive and statistically significant correlation between attracting inward investments to development management of higher educational activities ($\beta = 1.165$, $p < 0.001$). R&D collaborations also demonstrated a positive and statistically significant relationship ($\beta = 1.461$, $p < 0.001$). This means that hypothesis *H4* is also supported showing that HEIs are consequential on R&D outcomes. The positive high value of the coefficient 1.461 demonstrates there is a high probability that higher educational institutions in the United Kingdom contribute to regional development when they collaborate with other regional actors such as industries and governments. A positive and statistically significant relationship between attracting non-local students to regions and higher educational institutions development management activities is also evident ($\beta = 0.592$, $p < 0.047$), meaning it is probable that higher educational institutions can attract non-local residents to regions of the universities, and this can contribute to regional development. The results

show that there is also a positive and statistically significant relationship between regional development and development management, as seen from the high coefficient ($\beta = 1.501$, $p < 0.001$). Lastly, we found that there exists a positive and statistically significant association between facilitating networks and higher educational institutions development management ($\beta = 1.116$, $p < 0.004$). Our hypothesis *H5* is also confirmed. This means that higher educational institutions can facilitate networks, and this can positively contribute to regional development. However, four of the remaining variables were all not statistically significant at the 0.05 significance levels ($\beta = 0.805$, $p > 0.262$, $\beta = 0.209$, $p > 0.677$, $\beta = 0.453$, $p > 0.151$, $\beta = 0.248$, $p > 0.508$ respectively). Subsequently, the low values of the coefficients and the non-significant p-values indicate that the expected relationships are non-existent as anticipated. The surprising result means that it is not probable that knowledge exchanged by higher educational institutions could contribute to their development management activities. The results also show a low probability of small and medium-sized enterprises (SMEs) in the United Kingdom collaborating with higher educational institutions for knowledge and innovations.

We have established the causal relationships between the constructs. Although we believe that the binary logit model is not a biased estimator, it can be easily contaminated by the presence of confounding variables which can lead to unreliable and misleading results. This bias can result from either errors in the measurement instrument or the data collection approach. To overcome the issues of confounding, we used the propensity score matching technique to moderate the bias effect of any confounding variable (Baser 2006). Propensity score matching is a class of treatment effect analysis widely used in evaluation research to calculate average treatment effects (Caliendo, Kopeinig 2008). It is a quasi-experimental technique that allows a researcher to construct a non-natural control group by matching individually treated items with the controlled units of comparable attributes. The propensity score matching calculates the probability that universities will participate in development management activities based on observed qualities. The propensity score matching compares treated items to untreated items based on their fully calculated randomized propensity scores. The ATE determines the difference in mean of the outcomes among units allocated to the treatment and those assigned as the control. The average treatment effect can be calculated from the propensity scores by comparing the mean outcomes for both the treated and untreated component (Blundell, Dias 2002). The propensity score is used to calculate the probability that a variable with certain characteristics will be allocated to a treatment group. The scores help to eliminate selection bias by balancing independent variables between the control group and the treated group. We modelled our outcome variables as higher educational institutions development contributions while the treatment dependent variables were the various ways HEIs contribute to socioeconomic development. The teffects psmatch was estimated using the default values option. All variables included in the estimation of the preferred treatment assignment are shown in Tables 1 and 3. The results of the average treatment effects (ATE) of the population are presented in Table 4. The results show that five of the covariates; graduate support, attracting inward investments, R&D collaborations, regional development and network facilitations have positive and statistically significant correlations with the development management policies or programs of higher educational institutions. The results demonstrate that all these variables produce a positive and additional impact on HEI development management activities, which could have a potential impact on regional development.

5   Discussions

Universities have become pivotal in regional development due to the spill over effects of the knowledge they produce and disseminate from their campuses (Trippl et al. 2015). Most universities in recent times have tried to adjust and position themselves better to embrace their third mission which is making significant contributions to regional development. This recent trend reflects the fact that most universities are tying their existing traditional duties to a new role of direct engagement with other stakeholders like industries, and regional and national governments. Nonetheless, there exist some fundamental gaps in

Table 4: Average treatment effects of HEI contributions to development

Variables	Coef.	Std. Err	z	$P > z$
Knowledge exchange	-0.141	0.333	-0.42	0.673
Supporting SMEs	-0.126	0.412	-0.31	0.760
Graduate support	0.118	0.030	3.99	0.000***
Incubator support	0.078	0.061	1.28	0.199
Attracting inward investments	0.186	0.055	3.36	0.001***
R&D collaborations	0.494	0.030	16.64	0.000***
Attracting non-local students	-0.005	0.031	-0.17	0.864
Regional development	0.125	0.050	2.50	0.012**
Meeting regional skill needs	0.086	0.064	1.35	0.176
Facilitating networks	0.567	0.042	13.41	0.000***
Model summary				
Number of obs.		164		
Estimator		Propensity-score matching		

Source: Own calculations.

Note: *** Parameter significant at 99 % level, ** significant at 95 % level, * significant at 90 % level.

our understanding of the social impacts of these universities. In the United Kingdom, universities are documented as contributing to regional development, but our knowledge as to which aspect of regional development they make this impact upon remains very limited. With this in mind, we carried out an econometric analysis of which aspects higher educational institutions in the United Kingdom are likely to make a social impact. In this regard, our results show that higher educational institutions play additional roles in providing graduate support to assist with their regional development agenda. As seen from the ATE results, graduate support contributes on average 12 percentage points to the development management programs of higher educational institutions. Through the various levers of support available to graduate students, they can gain valuable knowledge that they can then use to contribute to the development of their regions after completion of their studies. The results are supported by a similar study by Smith, Beasley (2011) and Salomaa (2019) conducted in the United Kingdom. They found that the University of Lincoln has developed several graduate entrepreneurship activities and services to support the regional economy to retain graduates. These initiatives could equip graduates with the entrepreneurial skills they need to establish businesses or render services that can spur growth in the regional economy.

Simple initiatives aimed at increasing regional development and entrepreneurial prospects are shown to be ineffective in this regard. HEIs supporting the development of the private sector especially micro, small and medium-sized enterprises (MSMEs), did not demonstrate a contribution to increased entrepreneurship and regional development. Many young graduates dream of establishing their own businesses but lack proper business experience to be potential entrepreneurs, and in response, HEIs provide support to these potential entrepreneurs through business advice, mentoring and information on obtaining financial support. Our results did not identify any strong justification for HEIs involvement in this initiative. Many higher educational institutions have developed incubator support to promote enterprises and spin-off ventures, with the growth of these entities potentially contributing significant benefits to regional growth (Voisey et al. 2013). However, our results showed that the provision of incubator support by these universities did not provide any significant additionality effect to their regional development initiatives. Our results shouldn't be interpreted as demonstrating that proper incubator support provided by HEIs is insignificant, but rather that the level of support might need to be increased. These results show that the studied higher educational institutions are not effective in providing these support initiatives to benefit firms' growth and innovations. The results of our analysis differ from previous studies such as Soetanto, Jack (2016) that concluded that universities in the United Kingdom are proactive in incubation and entrepreneurial support such as networking, and that these initiatives have a positive

effect on the performance of SMES and spin-offs alike.

Similar results are also found for the variable of meeting regional skill needs; no evidence was found that HEIs regional development programs or policies helped to meet regional skill needs. This result mean that HEIs role in contributing to meeting a region's skill needs is insignificant, and that these programs and initiatives aimed at meeting the regional skills needs did not produce any additionality effects on regional development management. This result may indicate that these HEIs do not have regionally oriented courses or educational programs that might contribute to regional development and growth directly. The curriculum and course contents might not have the necessary domestic regional focus, and if so, would be unlikely to meet the regional skills need. This finding is contrary to that presented in the findings of Eriksson, Forslund (2014) where universities were proven to significantly contribute to the regional skills composition needs and therefore university induced knowledge spill overs to meet the regional skills needs.

In addition, these results show that higher educational institutions have a positive impact on attracting inward investments into their regions and catchment areas. This is a positive result, as the attraction of students, faculty and other non-academic staff to these regions contributes to an increase in the population of these regions and can subsequently influence investment decisions of central and regional governments (Guerrero et al. 2014). Within this context, higher educational institutions serve as hubs that can attract inward investment to their regions. The prestige and the status of a university can be a significant contributor to its ability to attract investment opportunities (Cattaneo et al. 2019). The results of the ATE show that, by fostering inward investments, universities create an additionality effect of contributing to regional development. Attracting inward investments contributes to higher educational institutions' regional development policies. HEIs in the United Kingdom attract about 19 percentage points of investment to their respective regions. These investments can significantly contribute to spurring regional growth and development. These results mean that, in the absence of these higher educational institutions, the studied regions wouldn't have attracted such inward investments. Despite our significant result, it however differs from the conclusions of previous studies by La Torre et al. (2019), which concluded that HEIs in the UK do not attract investment as a means of contributing to local regional development. This is because these institutions are not traditionally profitable economic entities. Although we cannot dispute the fact that research conducted by HEIs is shown to contribute to regional economies, the research investment they attract can also have spillover effects, which can help spur regional growth and development.

From the results analysis, it is evident that higher educational institutions' R&D collaborations with other regional stakeholders like industries and governments is positively associated with their regional development management. As described in the literature (see Benneworth, Fitjar 2019) these regional engagements enable HEIs to act as problem solvers by finding lasting solutions to regional problems. The literature suggests that a positive association between HEIs research productivity and its subsequent spillovers may significantly contribute to regional growth (Bonaccorsi 2017). This can improve existing problems, because they will conduct research and come up with sustainable solutions. The ATE results also demonstrate that R&D collaborations of HEIs have the highest coefficient (0.494). This means that the R&D collaborations of HEIs with other partners increase the propensies of improving their contributions to regional development management on average by 50 percentage points more than HEIs without these collaborations. This can be interpreted as showing that R&D collaborations undertaken by HEIs can create additionality impacts on regional development. In the United Kingdom, evidence of the impact that R&D collaborations of HEIs have on regional development is scant.

Contextualizing the results further to a regional development perspective, we have shown that HEIs are contributing to the development of their regions. This regional development mission produces a significant and positive role in the overall development management agenda of these HEIs. The results of the ATE show that the impact HEIs have on regional development intensifies when they are involved in direct community engagements and activities. HEIs that have policies in place, and engage in activities, at the community level, are more likely to improve their contributions to regional development

by on average 13 percentage points. Furthermore, the absence of these engagements reduces the likelihood of contributing to regional development, and this reduces the role of HEIs in development management by 87 percentage points. One aspect in which HEIs fulfil regional expectations can be through organizing training courses for the regions at large and offering trainings on how to develop small and medium-sized enterprises (SMEs). HEIs offer regional courses that can be used to cater for the respective region's needs, and their theoretical models can also be directly useful for regional development. Also, knowledge from HEIs play a crucial role in producing knowledge needed for regional development. Our result is supported by a related study by Klofsten et al. (2019), which finds that universities, especially entrepreneurial-focused ones, encourage changes that benefit the entire community and region where they are located.

Our results demonstrate that HEIs contribute significantly towards facilitating networks, pointing to a positive relationship between this variable and the contributions of HEIs to regional development management. HEIs bring people together in their catchment regions and facilitate networks which serve as a mobilizing force for regional development (Rutten, Boekema 2007). The ATE results show that network facilitation has the highest coefficient (0.567), meaning that it is the variable that has the highest likelihood to improve or significantly impact HEIs' regional development commitments. These networks promoted by HEIs usually bring regional experts to a single platform, where they can deliberate on aspects or sectors, they can work on to ensure regional development. HEIs that have policies and activities in place geared toward networking are likely to improve their regional development contributions by 57 percentage points more than HEIs without these initiatives. Some HEIs occasionally form networks that bring alumni who have flourished professionally back to their regions to become key figureheads and networkers. These HEI-initiated networks can pool together a wealth of talents and expertise that work towards solving immediate regional development challenges. The tacit knowledge and ideas shared from these networks and relationships promoted by HEIs can be transmuted into innovative ideas and policies that can contribute to regional growth.

6   Concluding remarks

This study was oriented towards addressing the third mission of universities as an active contributor to regional development efforts. We built our empirical analysis to evaluate the socioeconomic and additionality impacts of higher educational institutions' support and contributions to regional development and tested the variables that span these areas. We addressed HEIs' effectiveness in activities and initiatives that are anticipated to exert influences on their propensities to contribute to local and regional development. The set of hypotheses tested revealed that support for graduates, attracting inward investments, attracting university research and development collaborations, attracting non-local students, the development of the community, supportive knowledge networks, and efforts to meet regional skill needs, all strongly significantly contribute to higher education institutions regional development and management activities.

Theoretically, this research adds to the existing knowledge and literature on the role academia plays in regional development. This study fills a gap in the literature which had previously only lightly touched on the recurring contributions of academic institutions to regional development efforts. Practically, the results provide regional decision makers an understanding of the actual significance of both the socio-economic as well as academic roles universities occupy in the efforts to create regional value for all inhabitants. Having an understanding of the relative as well as actual contribution, this eases their task of deciding on sensitive areas to invest or provide support to create a multiplier effect on the economic impact of the regions concerned and the nation as a whole.

The main limitation of the study relates to the dataset used, which makes it difficult to use this study for generalization purposes. Though the sampling strategy focused on all higher educational institutions in the United Kingdom, the data was limited and did not shed enough light on certain characteristics of these institutions, for example: the size and scope of these institutions, the characteristics of a region such as its degree of specialization and innovativeness, and the existence, size, and role of specific intermediary

organizations like technology transfer offices (TTOs) and the regional distributions of these institutions. These characteristics could have broadened our understanding of the pivotal contributions these HEIs make in the regional innovation ecosystem. We suggest future research to incorporate these variables to build upon this study to deepen knowledge and understanding of the commitment HEIs to their third missions.

Disclosure statement

The authors do not have any potential conflict of financial, professional and personal interests relating to the contents described in this research.

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