Universities, students and regional economies

A symbiotic relationship?

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Abstract

We study the regionally heterogeneous effect of student spending in UK NUTS2 regions. Impact analyses of the £44bn students spend each year have so far been agnostic of the regional absorptive capacity to benefit from this expenditure. Building the first UK Multi-Regional Input-Output (MRIO) model and combining it with microdata, we find regional multipliers ranging from 1.11 to 1.37 for each £1 spent by a student. Similar variations are found in spillover effects and the importance of student spending to regional economies. The analysis shows a symbiotic relationship between student spending and regional industrial structures that produces varying impact outcomes.

Keywords: multi-regional input-output model, student expenditure, impact multipliers, regional industrial structures, higher education institutions

JEL: R11, R15, I23

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Supporting inclusive economic growth in the West Midlands and across the UK

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Introduction

Higher Education Institutions (HEIs)[1] have been hailed as significant contributors to their national and local economies where they act as catalysts of positive change (GODDARD et al., 2014; UPP FOUNDATION, 2019). Universities affect their home regions via several channels such as innovation, human capital, entrepreneurship and spending which is the focus of this paper. In 2014-15, a fraction of HEI activities (mainly spending, innovation and human capital channels) generated £95 billion of gross output for the UK economy, representing 3% of the country's economic activity and supported 940,000 jobs (OXFORD ECONOMICS, 2017).

These impacts are not evenly distributed across space but have a rather strong geographical footprint. 75% of Cardiff University's impact is expected to occur in Wales whilst the University of Birmingham with its 7,200 employees is one of the major employers in West Midlands (LONDON ECONOMICS, 2015, 2018). Universities are important for their local economies, fuelling local labour markets with skilled workers, engaging in knowledge transfer activities and generating spending to their local area. A testament of this increasing significance is the trajectory of the perceived role of universities from global knowledge institutions with loose connections to their local environment to the enterprising, engaged, mode 2 and the civic university models in more recent years (GODDARD et al., 2012; UPP FOUNDATION, 2019; UYARRA, 2010). Further to this, universities have also been seen and used as a tool for regional development in an attempt to assist productivity, demand and growth convergence among EU regions (LABRIANIDIS, 2010; PUGH, 2017).

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[1] In this paper we use the terms University and Higher Education Institution interchangeably.

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The majority of theorisations and impact evaluations have assumed that the absorptive capacity of regions to benefit from the presence of universities in their territory is guaranteed and spatially homogeneous. This "build it and they will come" approach has had mixed results in practice since not all places were ready or able to meaningfully engage with HEIs and benefit from knowledge spillovers and associated effects (PUGH, 2017). This led to several calls for contextual considerations and more place-based approaches instead of one-size fits all policies that assume positive benefits will flow just by the establishment of a university in an area.

Focusing on the impact of university spending, most studies avoid a geographical focus and instead emphasise the benefits of a university on the national economy. The difficulty in localising these effects stems from the lack of data on the relationships between industries within, as well as across regions. Hence, most studies tend to use information on industrial Input-Output (IO) relationships at the country level and identify effects that cannot be attributed in space. These approaches overlook i) the absorptive capacity of individual regions to benefit from spending, ii) the regional spillover effects (incoming and outgoing) of spending and, iii) the feedback effects flowing back to the original region. Consequently, whilst we know the level of spending generated by universities locally, we are yet agnostic on the spatial distribution of benefits.

We contribute to the literature on the socio-economic impact of HEIs by addressing these gaps. To do this we examine the effect of student spending on different UK NUTS2 regions, accounting for the heterogeneous regional industrial structures, as well as the inter-regional trade linkages in a stepwise approach. We first estimate the output impact of £1 spent by the average student in each of the

41 UK NUTS2 regions. Then, we consider inter-regional trade linkages to estimate the spillover effects in a region by student spending in other regions and the feedback effects returning to the region where the original spend has occurred. Finally, we multiply these impacts by the actual number of students and average spend in order to identify the actual output effect of student spending by region.

The impacts above depend on the nature and size of industrial relationships within and between different NUTS2 regions. Hence, we build the first MRIO model for the UK, using data from EUREGIO (THISSEN et al., 2018) and the Office for National Statistics (ONS) that allow us to represent inter-industry relationships at the intra- and inter-regional level. We combine this model with information on the distribution of student spending across different Classification of Individual Consumption by Purpose (COICOP) categories from the Living Costs and Food Survey (LCFS) (DEFRA, 2019) and student numbers by the Higher Education Statistical Agency (HESA, 2019).

Our findings highlight a symbiotic relationship between student spending and regional industrial characteristics. Regions benefit to different degrees from the same level of student spending. In addition, they contribute to the national economy at different degrees. We find the maximum direct effect to be 3.5 times the size of the minimum one, with an average £1 student spend generating 37 extra pence in Berkshire, Buckinghamshire and Oxfordshire and Greater Manchester but only 11 pence in North-Eastern Scotland. The results on the spillover effects are even greater. From £1 spent in each other region, Inner London West receives 40 pence when the Isles of Scilly receive 3 pence. Measuring the actual regional impact of this expenditure suggests that it is more important for some places rather than others.

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The observed differences highlight both the differential capacity of places to benefit from student expenditure and the mechanisms driving regional economic imbalances between London and other regions via the generation and receipt of spillover effects. Policy stakeholders should be aware of these differences in order firstly to adjust the expectations of student expenditure benefits and secondly to drive industrial policies that maximise the benefit of this expenditure. The latter could be achieved by both generating higher direct multipliers and by receiving more spillover benefits from expenditure in other regions.

The paper is structured as follows. Section 2 presents the background of university economic impacts touching on different theories and approaches to empirical examinations. This is followed by a discussion of our model construction and data. In section four we present our findings that are discussed in section 5 that also provides a conclusion and steps for further research.

Literature Review

There are multiple ways and channels in which universities contribute to their host region (BAGCHI-SEN and LAWTON SMITH, 2012; LAWTON SMITH, 2007; TRIPPL et al., 2015). These revolve around the generation and dissemination of innovation, the fostering of entrepreneurship, the provision of skilled workforce and the increase of expenditure. Theoretically, most of these contributions are centred on the emergence of the endogenous growth theory and models that stress the importance of technological change and knowledge on economic performance (LUCAS, 1988; ROMER, 1990). The progressive understanding of the importance of universities for regional development has led to the evolution of HEIs' identity from space-blind, knowledge generating institutions to active stakeholders and anchor

institutions in their local areas (BAGCHI-SEN and LAWTON SMITH, 2012; BREZNITZ and FELDMAN, 2012; GODDARD et al., 2014).

Human capital channel

The most intuitive contribution of universities to their host regions is through the production of human capital. Several theoretical and empirical contributions examine the mechanisms behind human capital effects on regional development. These range from growth (GENNAIOLI et al., 2013) and productivity (HERMANNSSON et al., 2014) impacts to resilience to economic crises (KITSOS and BISHOP, 2018) at the individual and aggregate level.

At the individual level, the work of Schultz (1961) introduced the idea of knowledge and skills as (human) capital whilst Becker (1962) and Mincer (1958) theorised and provided evidence of how this capital is formed and translated into higher earnings and productivity. Their proposition that education leads to greater earnings was contested by the idea of signalling (SPENCE, 2002) where the years of schooling and qualifications predominantly signal non-knowledge related attributes such as ambition and drive (HERMANNSSON et al., 2014). At the aggregate level, the work of Romer (1990) and Lucas (1988) on endogenous growth theory has highlighted the value of skills in generating and using technological change that fuels endogenous growth.

Empirically, a range of studies identify the benefits of education. Johansen and Arano (2016) and Hermannsson et al. (2014) find evidence of wage premia for graduates in the US and Scotland. Gennaioli et al. (2013) propose that education is a determinant of regional GDP per capita differences across 110 countries. Similar results are echoed by Valero and Van Reenen (2019) who find that the positive

relationship between the number of universities and GDP per capita growth they observe in 1500 regions across 78 countries is mediated by the supply of human capital. Interestingly, the positive growth effects of human capital do not appear to be influenced by the country level of development (MAROZAU et al., 2016) as is the case with the innovation channel discussed below.

Further to the growth effects, education is found to benefit regional development, indirectly. Moretti (2004) finds spillover effects in the form of greater wages for less-educated employees in places with more educated workers whilst Hermannsson et al. (2017) evidence the existence of technology and productivity externalities from graduate to non-graduate workers. Finally, the higher employment probabilities of graduates can have wider socio-economic benefits such as reduced criminality and enhanced resilience performance during economic crises (HERMANNSSON et al., 2014; KITSOS and BISHOP, 2018; MORETTI, 2004; WALKER and ZHU, 2007).

Innovation channel

Universities can also influence regional development via innovation activities. In Lendel's (2010) conceptualisation of the university as a multi-product industry, innovation generation and dissemination activities relate to four out of the seven identified products. Namely, *contract research*, *technology diffusion*, *new knowledge creation* and *new products and industries*. HEIs central role in innovation activity is brought to the fore by policy-oriented models and approaches such as the 'learning region' (MORGAN, 1997), Regional Innovation Systems (RIS) (ASHEIM et al., 2011; BENNEWORTH et al., 2017) and the 'triple helix' (ETZKOWITZ and LEYDESDORFF, 1997; PUGH, 2017). These models started with recognising the importance of the region as part of the national innovation

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landscape and evolved into conceptualisations that focus on the dynamics and interrelationships of local actors in generating benefits. An example of the above models is the 'triple helix' approach where universities are one of the three pillars of regional innovation and growth performance.

Empirically, several qualitative and quantitative studies have set out to identify the contribution of HEIs to regional development via the introduction, production and diffusion of innovation. Van Den Broek et al. (2019) argue that universities are uniquely placed in overcoming barriers to knowledge diffusion for regions located at national borders whilst Uyarra (2008) proposes that HEIs can increase the capacity of regions to receive and productively utilise knowledge. Anselin et al. (1997) provide econometric evidence of positive externalities among research at HEIs and high technology innovative activity in the U.S., whilst Valero and Van Reenen (2019) find a positive relationship between university innovation and GDP per capita in 1500 regions across 78 countries. Drucker and Goldstein (2007) provide an overview of numerous impact studies on the link between HEIs' knowledge-based activities and regional growth whilst Goldstein and Drucker (2006) find that, in the U.S., these effects are particularly relevant for small and medium sized regions where universities support the generation of agglomeration economies.

Contrary to these findings, several researchers suggest that the benefits of university innovation to regional economies are not as straightforward or significant as expected. Marozau et al. (2016) and Pugh (2017) argue that not all regions have the absorptive capacity to benefit by research-intensive institutions whilst Huggins and Johnston (2009) propose that not all universities are able to contribute to the same extent towards regional development. In particular, they

find that although less developed regions are more dependent on their local universities, the latter are less able, compared to their counterparts in more developed regions, to generate knowledge spillovers.

Entrepreneurship channel

Relevant to the generation and diffusion of knowledge, universities may contribute to regional growth via the relationship between knowledge and entrepreneurship. HEIs can affect entrepreneurship in three ways. Firstly, by generating knowledge that is used by local agents in order to provide new innovative products and services. Audretsch (1995) introduced the Knowledge Spillover Theory of Entrepreneurship where firms are able to take advantage of knowledge created at local research institutions. These ideas evolved to recognise entrepreneurial capital as a specific kind of capital alongside physical and human (AUDRETSCH and KEILBACH, 2004a). Entrepreneurial capital can identify exploitable knowledge and use it in a productive manner (AUDRETSCH and KEILBACH, 2004b). Importantly, these effects have been found to hold at the sub-national level (AUDRETSCH and LEHMANN, 2005) highlighting the importance of universities for their local areas. In more recent studies, the role of absorptive capacity has, once again been raised (QIAN and ACS, 2013) stressing the importance of a symbiotic relationship between local contextual factors and the maximisation of benefits arising from university knowledge spillovers and entrepreneurship.

The second way for universities to contribute to local growth via entrepreneurship activities is by setting-up businesses to commercialise research (GODDARD et al., 2014; LAWTON SMITH and BAGCHI-SEN, 2006). The mechanisms for translating this university activity into regional growth are similar to the discussion above.

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University spin-offs utilise knowledge, generated by university research in order to deliver innovative products and services.

Further to these activities, universities teach entrepreneurship and thus have the ability to influence a region's entrepreneurial culture (LAWTON SMITH and BAGCHI-SEN, 2012; PUGH et al., 2018). Current research suggests that entrepreneurship departments have a double role to play (PUGH et al., 2018). Firstly, within their universities, they can influence the approach and entrepreneurial environment in exploiting opportunities. Secondly, entrepreneurship departments may act as a regional stakeholder and affect the culture of entrepreneurship at the regional level (ibid.).

At the empirical level, several studies examine the regional benefits of HEIs' entrepreneurship-related activities. Drucker (2016) finds a link between entrepreneurship rates and degrees in science and engineering whilst Audretsch and Lehmann (2005) find that young, high-tech firms tend to cluster in greater numbers around research intensive universities. Similar effects are echoed by Guerrero et al. (2015) who distinguish HEIs' positive economic impacts in two sources. In particular, they argue that the most entrepreneurial universities in the U.K. generate benefits via spin-offs whilst the rest of them through knowledge transfer activities. In contrast, Marozau et al. (2016) suggest that the benefits of HEIs' entrepreneurial activities accrue only in advanced, innovative economies and not across the board.

The evolving identity of HEIs

The evolution of understanding around the universities' contributions to their local economies was followed by the development of different university models

attempting to capture the multiple identities of universities. Even though these models have been developed sequentially, they now present a spectrum along which, HEIs find themselves subject to the national and regional policy context. The range starts with the university as a 'knowledge factory' (or mode 1) and ends in the 'civic university' (or modes 2 and 3) (TRIPPL et al., 2015; UPP FOUNDATION, 2019; UYARRA, 2010).

As a 'knowledge factory', the university is primarily concerned with the generation of new knowledge. It forms relationships with firms that already have absorptive capacity and delivers regional benefits in the sense of knowledge spillovers (UYARRA, 2010). In addition to the generation of knowledge, the 'relational university' is focused on the co-production and sharing of knowledge with industry partners (ibid.). Realising the potential monetary value of university knowledge has led to the development of the 'entrepreneurial university' (PUGH et al., 2018; TRIPPL et al., 2015; UYARRA, 2010) where HEIs are expected to formalise knowledge transfer partnerships and establish technology transfer offices. This allows them to commercialise their knowledge production and secure the pecuniary benefits of their intellectual property.

The RIS and triple-helix approaches to regional growth support a more institutional function for HEIs. Universities are considered active stakeholders that shape regional development through a multitude of channels beyond the commercialisation of activities (TRIPPL et al., 2015). Uyarra (2010) identifies this model as the 'systemic university' to signal the HEIs' involvement in a socio-economic system of actors. One of the most recent university models is that of the 'engaged' or 'civic' university (GODDARD et al., 2012; UPP FOUNDATION, 2019; UYARRA, 2010). In this, HEIs are regarded as an anchor institution that is responsive

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to local needs and responsible for contributing to the socio-economic and cultural development of their local areas (BREZNITZ and FELDMAN, 2012; TRIPPL et al., 2015).

Spending channel

Irrespective of these functional models, universities always impacted their host area by generating student spending, increasing local demand for goods and services. This initial demand translates into further demand for inputs and other goods and services, creating knock-on effects down supply chains and local economies. The majority of studies examining these effects use information on sectoral relationships in a certain economy, and either consider all students (HARRIS, 1997) or the ones coming from outside the region (KELLY et al., 2004) as additional expenditure. In this way, they find multiplier effects of spending on particular products. The availability of Input-Output (IO) information at the national level has enabled the examination of the impact of HEI spending at the country level, and the approximation of such impact for specific regions. However, to the best of our knowledge, no study has examined the impact of HEI student spending on all the regions in the UK in a systematic manner.

Oxford Economics (2017) analyses the short-term impact from 162 universities in the UK for 2014-15. Using a UK-wide IO model, and information on HEIs' operational spending as well as the expenditure of international students and their visitors, they find a contribution of £52.9 billion in terms of Gross Value Added (GVA). This supports £940,000 jobs and represents 2.9% of the UK GDP. London Economics has produced similar assessments both for individual universities such as the University of Birmingham (LONDON ECONOMICS, 2018) and Cardiff

University (LONDON ECONOMICS, 2015), and for groups of universities such as the Russell Group (LONDON ECONOMICS, 2017).

Pereira López et al. (2016) assess the economic impact of international students and their visitors in Galicia's regional economy in comparison to conventional tourists in the region. With the help of an IO model specific to the region, and a consumption demand vector based on survey data, they find that the direct and indirect impacts of international students are significantly lower than those of conventional tourists. This has significant practical applications both in terms of impact expectations and in terms of policy focus in developing regional growth initiatives.

Hermannsson et al. (2013) examine the level of heterogeneity on the expenditure impact of Scottish HEIs. They distinguish between HEI and student consumption expenditures and use a purpose-built IO table for Scotland that is disaggregated for each individual university. Assuming student expenditure is representative of household spending, they find that the heterogeneity of the impact of different HEIs on the Scottish economy is driven by the types of expenditure and its scale. However, translating this impact into local multipliers, universities appear to uniformly affect their regions.

This paper contributes to this literature by considering the student expenditure effects for all regions in the UK simultaneously. Beyond the direct effects, this allows us to consider the knock-on effects this spending has in various supply chains and follow an increase in demand across its trajectory through the regional economic structure. In addition, by using microdata, we can account for the different structure of student spending in comparison to the average household.

Methods - Data

The Multi-Regional Input-Output (MRIO) framework

We use an MRIO framework to better understand the regional effects of student expenditure. To do this, we focus on the role of local industrial structures and relationships, together with trade spillovers and feedback effects. The IO relationships between industries at the regional level enable us to understand the regional absorptive capacity of student spending. On the one hand, interregional trade spillovers show us the transmission of impacts from one region to another, whilst the feedback effects consider the trajectory of the impact back to the region of origin (Figure 1). In this way, we can account for both direct and indirect effects.

IO models are the most appropriate tool for the study as they allow us to estimate the gross macroeconomic effects (direct and indirect) of an increase in spending, and to disaggregate these effects by industry (HERMANNSSON et al., 2013; PEREIRA LÓPEZ et al., 2016). Their simplicity, transparency and relative ease of use and interpretation of the results (in contrast to Computable General Equilibrium models) make them the most commonly used tools in impact evaluation studies. Simultaneously, by focusing on a phenomenon that it is happening, i.e. actual students spending in the way they spend in the present (in contrast with hypothetical impact shocks), we avoid the limitations of traditional IO model around the lack of supply restrictions[2] (MILLER and BLAIR, 2009).

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[2] Due to these restrictions, Input-Output models are often regarded as a short-run impact model (as a quantity model where prices cannot be changed in the short-run) and Computable General Equilibrium models as a preferred option in dealing with medium and long-run effects.

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In a single-region IO model, domestic[3] output can be defined as:

$$x^d = \left(I - A^d\right)^{-1} f^d$$

x^d is the vector of total domestic output by industries, $\left(I - A^d\right)^{-1}$ is the domestic Leontief's inverse[4] (excluding intermediate imports) and f^d is the exogenous domestic final demand vector. Knowing the final demand, we can obtain the value of the required output in each industry to satisfy it. Hence, this model can show us how regional production changes in response to changes in final demand (CARRASCAL INCERA et al., 2015), and the total contribution, direct and indirect, of a particular spending pattern.

To identify the impact of an increase in demand, IO approaches use the concept of economic multipliers. These show the effect of an additional unit of consumption on the economy. Beyond the direct impact of the expenditure, multipliers take into consideration the indirect effects. These are knock-on effects, arising from the increase in demand along value and supply chains. For example, having an extra meal at a restaurant (increase in demand for catering & hospitality services), beyond its direct effect, also represents an increase in the demand for the inputs of the restaurant, generating further demand increases down the supply chain.

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[3] Domestic flows do not consider imported flows. The model expressed in domestic terms is used in impact analyses for excluding the possible leakages to other regions and the overestimation of the effects calculated.

[4] It is composed by the subtraction of the identity matrix (I) and the coefficients matrix (A). The inverse of those elements reflects a power series of the A matrix where $I + A$ are the direct effects and the subsequent $A^2 + A^3 + \dots + A^\infty$ the indirect effects. It should be noted that because of just considering domestic inputs and outputs this A matrix do not reflect technologies of production but domestic coefficients of production.

The MRIO model has two advantages compared to single-region IO models. Firstly, it can locate where the production will take place in order to satisfy the increased demand. As a result, we can simultaneously identify local effects and the impacts on other regions (spillover effects). This type of model produces estimations of both regional and national effects, consistently dealing with intra-regional and inter-regional impacts (OOSTERHAVEN and HEWINGS, 2014).

Secondly, the MRIO model allows us to estimate inter-regional feedback effects. These are defined as the impact on the initial region arising from the indirect effect of production in other regions that were due to an increase in demand in the initial region. The literature on feedback effects has found that, on average, they represent 1 to 10 per cent of the total intra-regional indirect effect (CARRASCAL INCERA et al., 2015), depending on the size of the sub-national economy. Figure 1 explains graphically the direct, spillover and feedback effects.

Figure 1 - Spillover and feedback effects in MRIO models.
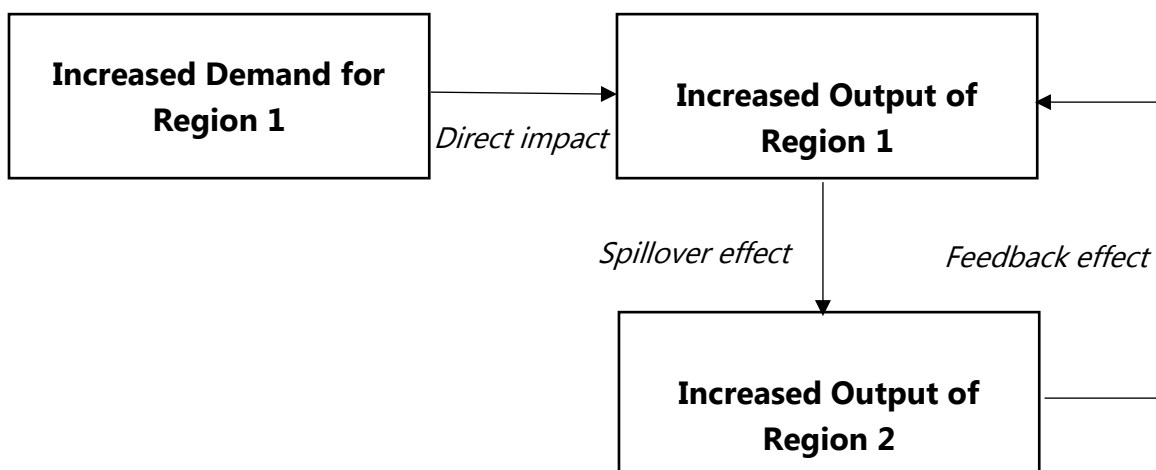
Source: own elaboration

For a region *r*, the structural form of the MRIO model is:

$$x^r = (I - A^{rr} - A^{rs}(I - A^{ss})^{-1}A^{sr})^{-1}f^r$$

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where x^r is the output of region r and f^r the vector of exogenous final demand. A^{rr} and A^{ss} are the intra-regional matrix of region r and region s, respectively, and A^{rs} and A^{sr} the inter-regional trade matrices between the two regions (from r to s and from s to r). In this way, different regional specialisations can be considered along with different patterns of intermediate imports and exports.

The two-region MRIO model can also be expressed in a matrix format as:

$$\begin{pmatrix} x_d^r & x^{rs} \\ x^{sr} & x_d^s \end{pmatrix} = \left(\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} - \begin{pmatrix} A^{rr} & A^{rs} \\ A^{sr} & A^{ss} \end{pmatrix} \right)^{-1} \begin{pmatrix} f^r & 0 \\ 0 & f^s \end{pmatrix}$$

where, by multiplying with the final demand as a diagonal matrix ($\hat{f}$), we obtain the output (x) disaggregated between the domestic/own effect (x_d^r and x_d^s) and the impact that comes from a different region (x^{sr} is the effect in regions coming from the final demand in r, and vice versa for x^{rs}). This is also described in Figure 2.

Figure 2 - Domestic effects and incoming and outgoing spillover impacts.
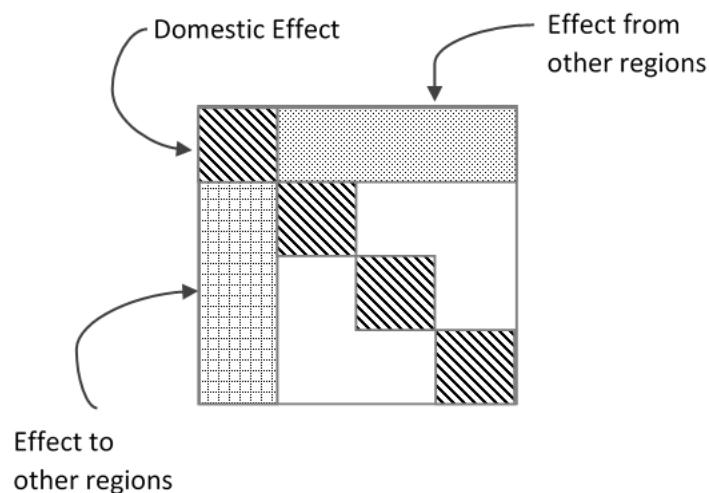
Source: own elaboration

Consequently, trade relations between regions within a national economy (in our case, the UK) can affect the impact of student expenditure on regional economies. The indirect effects of this expenditure span beyond the regional economy in which the consumption originates to regions that supply intermediate inputs. The MRIO model enables us to account for these channels and offers significant insights into the impact of students on regional economies and the capacity of these economies to benefit from this expenditure.

Once the regional multipliers are calculated, we can easily measure the contribution of student spending to each regional economy. To do this, we multiply the number of students in each region by their average expenditure and their domestic multiplier. These are expected to provide interesting insights in the heterogeneous effects of student spending in UK regions.

Data – Model

To perform our analysis we use the Socio-Economic Impact Model of the UK (SEIM-UK). The SEIM-UK is an MRIO that covers 41 UK regions (NUTS2 classification) and 30 sectors (see tables 1 and 2, respectively). This model was built using information from the UK Supply and Use Tables (SUTs) for the year 2016. Hence, all estimations of the regional variables mentioned above will be consistent with the national total for 2016. The sum of output and demand components by NUTS2 regions is equal to the total for the UK in the SUTs.

The SUTs and the regional UK information allow us to estimate regional weights for the MRIO margins (i.e. total primary inputs, imports and final demand) based on the most disaggregated information available from the Office for National Statistics (ONS). The constraint in the number of sectors considered in the SEIM-

UK comes from the components of the value-added by industry (compensation of employees, gross operating surplus and mixed income) for NUTS2 regions.

For the inter-regional IO table, estimations are based on applying the relationships from UK national datasets to the NUTS2 level at a 68-industry level (from the Gross Value Added of the Regional Accounts (ONS)). When data is aggregated to 30 industries, the heterogeneity observed within industries across regions is mainly the result of different production and demand structures of industries within the 30 industry-level. In sum, sectoral mix and regional industrial specialisation will be the key element that would differentiate regional economic structures.

We use the Cross-Hauling Adjusted Regionalisation Method (CHARM) (TÖBBEN and KRONENBERG, 2015) to construct the SEIM-UK model. Beyond the SUTs, other databases involved in the model development are: 1) the Regional Accounts (ONS) for the components of GVA, and for obtaining regional domestic output; 2) the Regional Household Final Consumption Expenditure, Regional Gross Disposable Household Income and Living Costs and Food Survey (LCFS) for the regional weights of the final consumption by region; 3) the Public Expenditure Statistical Analysis (PESA) released by HM Treasury for the public consumption by region; 4) the Regional Gross Fixed Capital Formation from ONS for the investment; and 5) HM Revenues and Customs information and the EUREGIO database for the exports and imports. The final adjustments to achieve global consistency have been made using the well-established RAS method (BACHARACH, 1970; STONE, 1961).

Estimating the final demand vector

To identify the final demand vector of HEI students, the main source of data is the LCFS (DEFRA, 2019). We use microdata on student expenditure for the years 2011-

2016 to avoid distortions in the student consumption profile due to the relatively small sample size or to a particular year effect. Rents, mortgages, holidays, utility bills, etc. reported at the household-level is captured during interviews with household members, which means that they do not appear at the individual microdata level. To include expenditure on housing made by students we use the information from the main LCFS tables released by the ONS[5]. The same holds for the Education fees that are paid annually[6].

Of particular interest are the shares of student spending by COICOP category (table 1). During 2011-2016, student expenditure primarily revolved around payment for accommodation (24.9%), university fees (20.5%) and the purchase of food and beverages. These products account for 70.9% of the total consumption by university students. Alternatively, for every £1 a student spends, 71 pence go to Real Estate activities, Education and food & beverages.

The total consumption vector (Table 1) is formed of 30 products/sectors. The vector is estimated following two transformations. First, we use the consumption Bridge Matrix from the SUTs to obtain consumption by 30 industries (e.g. from COICOP products to SIC industries). Second, we translate the spending by students from purchasing prices to producer prices (IO figures are at basic prices) by deducting transport costs margins and indirect taxes. This vector is the one used as the exogenous part of the MRIO model to derive the multipliers and the contribution of student spending to regional economies.

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[5] Tables 2.6 "Housing expenditure by socio-economic classification of household reference person", formerly Chapter 2.
[6] Tables A22 "Household expenditure by socio-economic classification of household reference person".

Table 1 - Final demand vector for students in the UK (30 sectors).

Code	Sector	Composition %
A	Agriculture, forestry and fishing	1.54%
B	Mining and quarrying	0.04%
CA	Manufacture of food, beverages and tobacco	5.59%
CB	Manufacture of textiles, wearing apparel and leather	3.27%
CC	Manufacture of wood and paper products and printing	0.43%
CD-CF	Manufacture of petroleum, chemicals and pharmaceuticals	2.31%
CG	Manufacture of rubber, plastic and non-metallic minerals	0.40%
CH	Manufacture of basic and fabricated metal products	0.25%
CI	Manufacture of computer, electronic and optical products	0.84%
CJ	Manufacture of electrical equipment	0.26%
CK	Manufacture of machinery and equipment	0.11%
CL	Manufacture of transport equipment	1.15%
CM	Other manufacturing, repair and installation	0.87%
D	Electricity, gas, steam and air-conditioning supply	2.54%
E	Water supply; sewerage and waste management	1.12%
F	Construction	0.62%
G	Wholesale and retail trade; repair of motor vehicles	9.94%
H	Transportation and storage	3.77%
I	Accommodation and food service activities	9.91%
J	Information and communication	2.06%
K	Financial and insurance activities	2.11%
L	Real estate activities	24.93%
M	Professional, scientific and technical activities	1.03%
N	Administrative and support service activities	0.02%
O	Public administration and defence; compulsory social security	0.52%
P	Education	20.46%
Q	Human health and social work activities	0.78%
R	Arts, entertainment and recreation	1.94%
S	Other service activities	0.84%
T	Activities of households	0.35%
	Total	100.00%

Source: own elaboration

Findings

Multipliers results: own effect and total effect

We find large heterogeneity in the regional impact of £1 spent by a HEI student in each region (Table 2 and Figure 3). The domestic multipliers range from 1.11 in

North-Eastern Scotland (UKM5) to 1.367 in Berkshire, Buckinghamshire and Oxfordshire (UKK1) and in Greater Manchester (UKD3). Per £1 spent, 36.7 extra pence will be generated in UKD3 and UKK1, whilst only 11 pence will be generated in UKM5. The way products arrive in regions (produced locally vs imported from outside the region) affects the size of the multipliers and highlights the symbiotic relationship between regional economies and student expenditure.

Not all the impact generated locally remains in that region. The second column of Table 2 shows the impact of students' consumption on the whole of the UK. A similar regional variation is observed, with multipliers ranging from 1.543 when the spend occurs in West Midlands (UKG3) to 1.163 for expenditure in UKM5. Differences reflect the longitude of the supply chain of each product and the origin of the suppliers (national vs. foreign-based). As can be seen in Table 2, denser regions are the ones with a greater effect on the UK economy as a whole, which makes sense in terms of the greater economic scale and connectivity of highly populated urban areas.

Examining the ratio between the domestic (own effect) and total multiplier (UK effect) suggests that even though most of the expenditure is on non-tradable services (education, real estate, etc.) there are significant differences in the impact retention rates. Denser regions have a lower impact retention, with Inner London West (UKI3) at 82.2% and West Midlands (UKG3) at 86.3% at the bottom and Cumbria (UKD1) and Cornwall and Isles of Scilly (UKK3) at the top with ratios over 96%. This outcome is expected since the latter regions host their local food production supply chains, whereas more urban areas need to import goods to satisfy their food consumption demand. Again, this result is rooted in the level of integration the region has into the economic system: denser regions have more

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trade connections with others, meaning greater impacts but also more "escape routes".

Table 2 - Regional output multipliers and percentage of the own effect.

Region Code	Region Code	Domestic multiplier – Own effect	Output multiplier – UK effect	Percentage over the total impact of students (%)
UKC1	Tees Valley and Durham	1.227	1.290	95.0%
UKC2	Northumberland and Tyne and Wear	1.269	1.371	92.6%
UKD1	Cumbria	1.153	1.191	96.8%
UKD3	Greater Manchester	1.367	1.494	91.5%
UKD4	Lancashire	1.255	1.344	93.3%
UKD6	Cheshire	1.211	1.307	92.7%
UKD7	Merseyside	1.250	1.352	92.5%
UKE1	East Yorkshire and Northern Lincolnshire	1.180	1.242	95.0%
UKE2	North Yorkshire	1.274	1.335	95.4%
UKE3	South Yorkshire	1.228	1.303	94.3%
UKE4	West Yorkshire	1.297	1.457	89.0%
UKF1	Derbyshire and Nottinghamshire	1.273	1.382	92.1%
UKF2	Leicester, Rutland and Northampton	1.293	1.395	92.6%
UKF3	Lincolnshire	1.184	1.231	96.2%
UKG1	Hereford, Worcester and Warwick	1.264	1.358	93.1%
UKG2	Shropshire and Staffordshire	1.240	1.325	93.6%
UKG3	West Midlands	1.332	1.543	86.3%
UKH1	East Anglia	1.337	1.452	92.1%
UKH2	Bedfordshire and Hertfordshire	1.269	1.385	91.7%
UKH3	Essex	1.290	1.375	93.8%
UKI3	Inner London - West	1.207	1.468	82.2%
UKI4	Inner London - East	1.232	1.394	88.4%
UKI5	Outer London - East and North East	1.220	1.335	91.4%
UKI6	Outer London - South	1.247	1.329	93.8%
UKI7	Outer London - West and North West	1.280	1.416	90.4%
UKJ1	Berkshire, Buckingham and Oxford	1.297	1.489	87.1%
UKJ2	Surrey, East and West Sussex	1.360	1.504	90.4%
UKJ3	Hampshire and Isle of Wight	1.311	1.415	92.6%
UKJ4	Kent	1.342	1.415	94.8%
UKK1	Gloucestershire, Wiltshire and Bristol/Bath	1.367	1.485	92.0%
UKK2	Dorset and Somerset	1.320	1.390	94.9%
UKK3	Cornwall and Isles of Scilly	1.152	1.195	96.4%
UKK4	Devon	1.270	1.336	95.1%

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UKL1	West Wales and The Valleys	1.246	1.347	92.5%
UKL2	East Wales	1.275	1.365	93.4%
UKM5	North Eastern Scotland	1.110	1.163	95.4%
UKM6	Highlands and Islands	1.170	1.217	96.1%
UKM7	Eastern Scotland	1.344	1.475	91.1%
UKM8	West Central Scotland	1.323	1.408	94.0%
UKM9	Southern Scotland	1.217	1.259	96.7%
UKN0	Northern Ireland	1.230	1.359	90.5%
Average		**1.261**	**1.363**	**92.5%**

Source: own elaboration

Figure 3 - Domestic impact of students in the UK regions
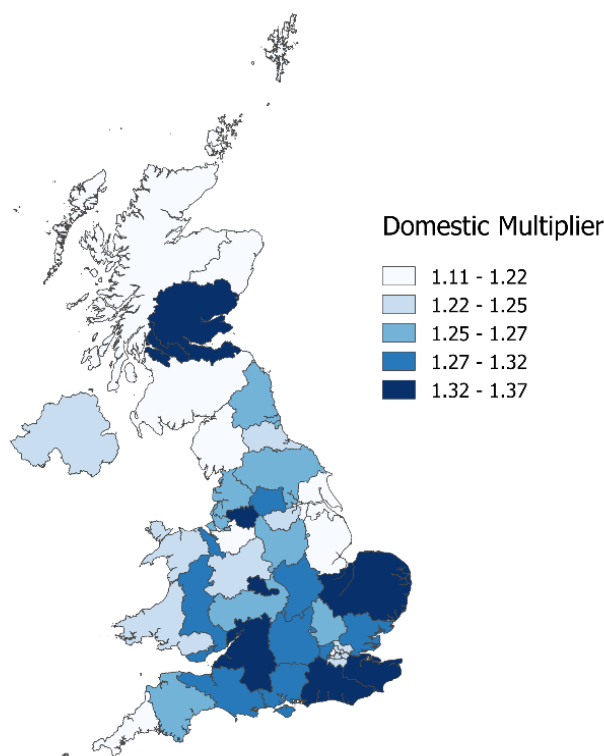
Source: own elaboration

Analysis of the regional spillover effects

We now turn our attention to the spillover effects generated by student spending (Table 3). Here we are comparing how much a region generates to another when a HE student spends £1, and how much it receives from that other region when the

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expenditure happens in the latter. Regional heterogeneity is observed in both the impact generated to other regions (first column) and the effects received from £1 spent in each of the other regions (second column). On average, for every £1 spent, 10 extra pence are generated in spillover effects in a process that has net receivers and senders of spillover effects (third column).

The regions creating most of the spillover effects to other regions are predominantly urban such as Inner London West (UKI3), which generates 26 extra pence in other regions, and West Midlands (UKG3), with 21 pence (Table 3 and Figure 4). On the other hand, we find more rural regions such as Cumbria (UKD1) and Cornwall and Isles of Scilly (UKK3) generating a spillover effect between 3 and 5 pence. The spillovers received by regions (table 2 - column 2 and figure 5) resemble the country's regional economic imbalances. The places benefiting the most from student spending in other regions are in or around London.

Table 3 - Spillover effects and balance

Region Code	Region Name	Spillover effects to other regions (A)	Spillover effects from other regions (B)	Balance (A - B)
UKC1	Tees Valley and Durham	0.064	0.042	0.022
UKC2	Northumberland and Tyne and Wear	0.101	0.054	0.047
UKD1	Cumbria	0.038	0.043	-0.005
UKD3	Greater Manchester	0.126	0.116	0.010
UKD4	Lancashire	0.090	0.051	0.039
UKD6	Cheshire	0.096	0.105	-0.009
UKD7	Merseyside	0.102	0.055	0.046
UKE1	East Yorkshire and Northern Lincolnshire	0.062	0.091	-0.028
UKE2	North Yorkshire	0.061	0.044	0.018
UKE3	South Yorkshire	0.075	0.056	0.018
UKE4	West Yorkshire	0.160	0.091	0.069
UKF1	Derbyshire and Nottinghamshire	0.109	0.110	-0.001
UKF2	Leicester, Rutland and Northampton	0.103	0.149	-0.046
UKF3	Lincolnshire	0.047	0.042	0.004
UKG1	Hereford, Worcester and Warwick	0.094	0.104	-0.010

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UKG2	Shropshire and Staffordshire	0.085	0.078	0.007
UKG3	West Midlands	0.211	0.100	0.111
UKH1	East Anglia	0.115	0.132	-0.017
UKH2	Bedfordshire and Hertfordshire	0.115	0.160	-0.045
UKH3	Essex	0.085	0.088	-0.003
UKI3	Inner London - West	0.261	0.394	-0.133
UKI4	Inner London - East	0.162	0.259	-0.096
UKI5	Outer London - East and North East	0.115	0.071	0.045
UKI6	Outer London - South	0.083	0.089	-0.006
UKI7	Outer London - West and North West	0.136	0.225	-0.089
UKJ1	Berkshire, Buckingham and Oxford	0.192	0.202	-0.009
UKJ2	Surrey, East and West Sussex	0.144	0.181	-0.037
UKJ3	Hampshire and Isle of Wight	0.104	0.155	-0.050
UKJ4	Kent	0.073	0.107	-0.034
UKK1	Gloucestershire, Wiltshire and Bristol/Bath	0.118	0.127	-0.009
UKK2	Dorset and Somerset	0.071	0.042	0.029
UKK3	Cornwall and Isles of Scilly	0.043	0.028	0.016
UKK4	Devon	0.066	0.033	0.033
UKL1	West Wales and The Valleys	0.101	0.082	0.019
UKL2	East Wales	0.090	0.058	0.032
UKM5	North Eastern Scotland	0.053	0.081	-0.027
UKM6	Highlands and Islands	0.047	0.042	0.005
UKM7	Eastern Scotland	0.131	0.113	0.018
UKM8	West Central Scotland	0.085	0.051	0.034
UKM9	Southern Scotland	0.041	0.054	-0.013
UKN0	Northern Ireland	0.129	0.082	0.047
Average		**0.102**	**0.102**	

Source: own elaboration

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Figure 4 - Regional spillover effects to other regions
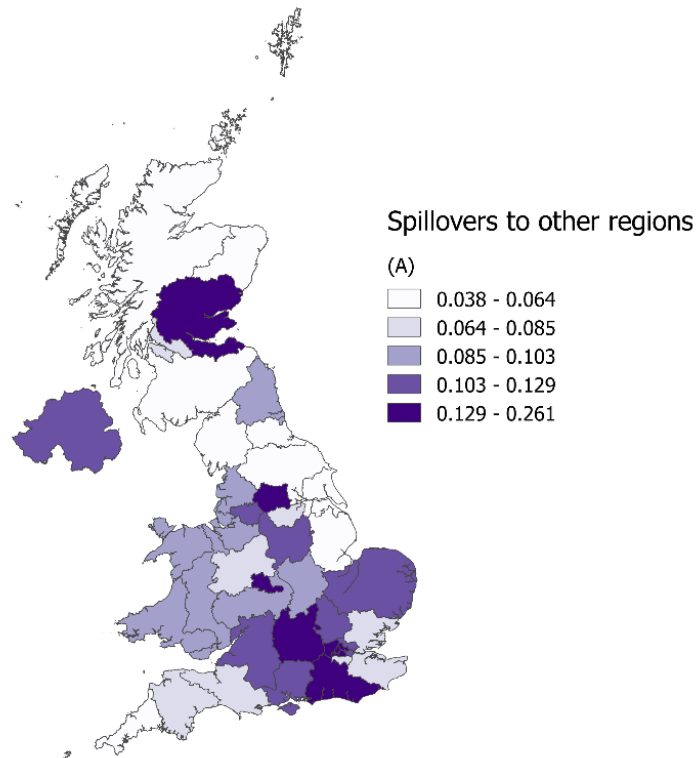
Source: own elaboration

Figure 5 - Regional spillover effects from other regions.
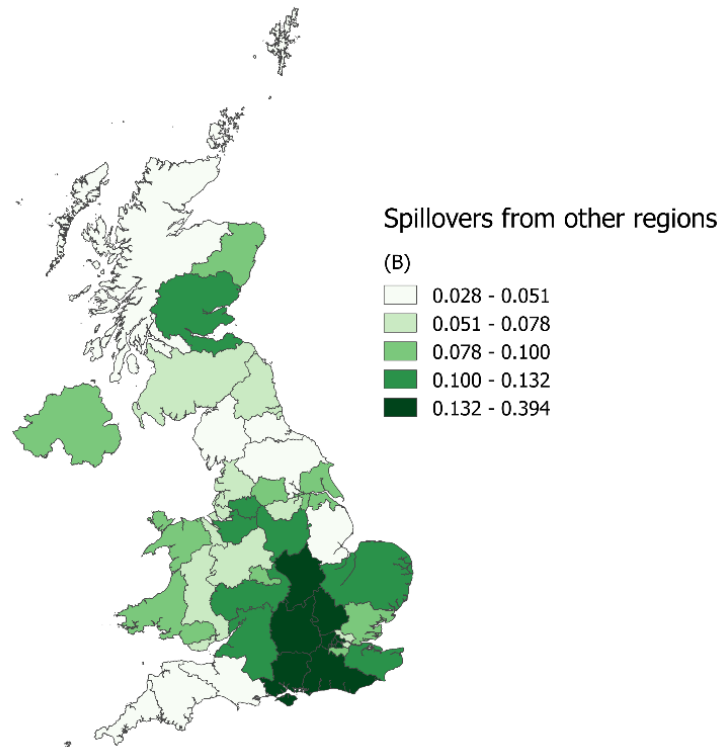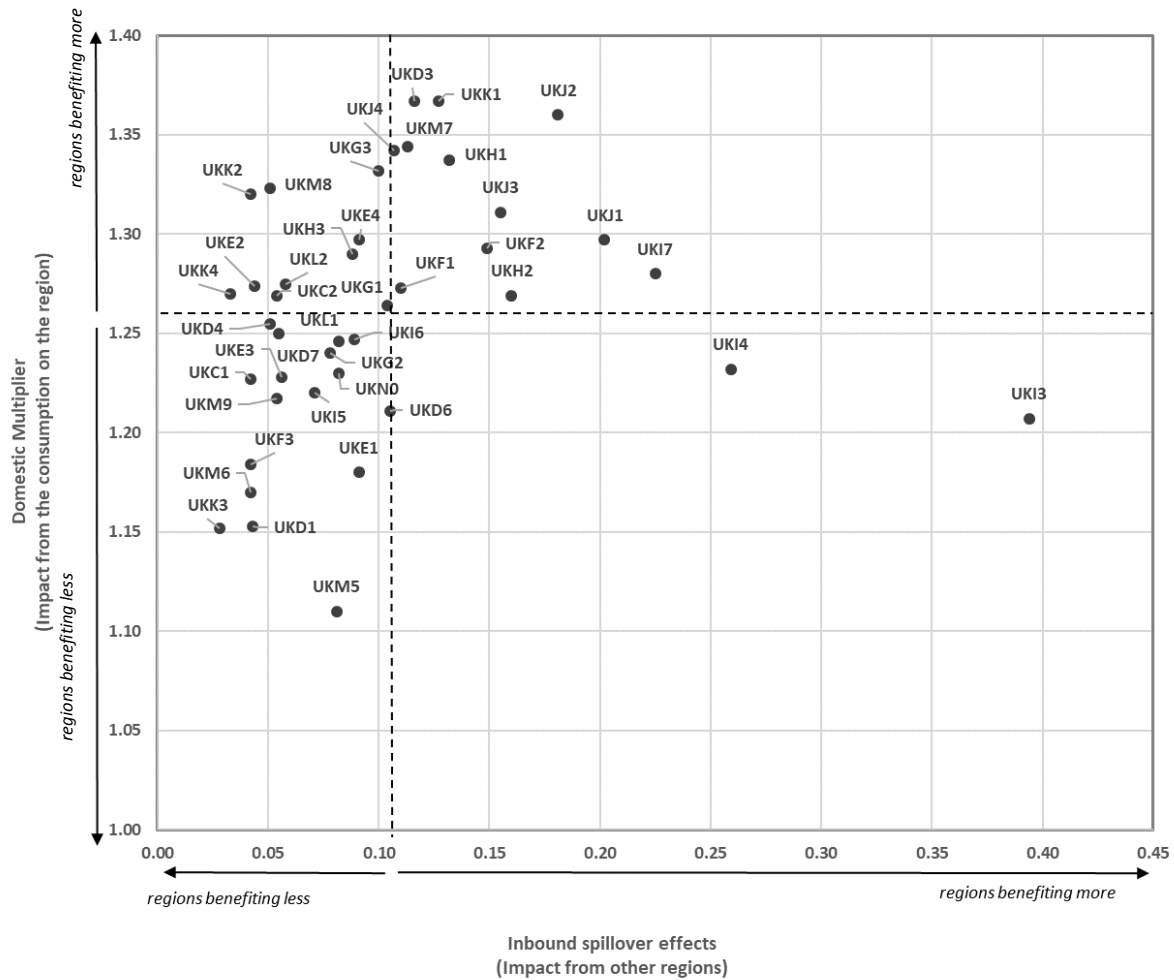

Source: own elaboration

The balance between spillovers generated and received reveals regions that create more indirect benefits than they receive, and vice versa (table 2 – column 3). West Midlands (UKG3) has the largest positive balance, generating 11 pence more in other regions than it receives, whilst Inner London West (UKI3) receives 13 pence more than it generates. The above results are explained by the local industrial structures and IO relationships among local industries. The lack of food supply chains in more urban regions means that they will tend to generate more spillovers to other regions whilst London's dominance on services draws most of the spillover

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effects from other regions. Figure 6 graphically represents the relative position of each region with regards to the average domestic and spillover effects.

Figure 6 - Quadrant of own effect and spillovers from other regions.

Source: own elaboration

The dashed lines in the figure indicate the average domestic effect (vertical axis) and the average spillover effect received (horizontal axis). Under this structure, four types of regions arise:

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1. In the bottom-left quadrant we find regions that benefit below the average from the presence of HE students both in the region and in other regions. According to the graph, these regions would gain from improving their absorptive capacity, i.e. strengthening the links between their HEI and the local producers, but also from establishing further trade relationships with other regions to try to capture more spillover effects. This is the situation of regions like North Eastern Scotland (UKM5), Cumbria (UKD1) or Cornwall and Isles of Scilly (UKK3)

2. The top-left quadrant gathers regions with high absorptive capacity (domestic effect above average), but not as good spillover inflow. In this group we find The West Midlands (UKG3), West Yorkshire (UKE4) or Essex (UKH3), among others.

3. Regions in the bottom-right quadrant are very good at capturing spillover effects from HE students' consumption in other regions but cannot keep the direct effect to the same extent. As stated earlier, these are metropolitan regions engaged in very long supply chains, namely Inner London East (UKI4) and West (UKI3).

4. Finally, regions in the top-right quadrant are the ones enjoying a stronger symbiotic relationship, not only with the expenditure of their own students but also with the one made in other regions. In this golden group we find, for example, Outer London – West and North West (UKI7), Berkshire, Buckinghamshire and Oxfordshire (UKJ1), and Surrey, East and West Sussex (UKJ2).

The contribution of students to regional output

Once we calculate the domestic and total multipliers, we can estimate the actual impact of student spending in each region (table 4) using data on the number of students per region (HESA, 2019) and their average spend (DEFRA, 2019; NATWEST, 2019; THE, 2017)[7].

Table 4 ranks regions based on their student populations and shows the symbiotic relationship behind the impact of student spending on regional economies. The domestic multipliers in combination with the number of students are behind the variability of actual impacts by region, whilst the size of the local economy co-determines the importance of this spend locally. As a result, we see that the 88,865 students of Gloucestershire, Wiltshire and Bristol/Bath region (UKK1) generate more impact than the 91,320 students of West Yorkshire (UKE4). Similarly, we find that the 74,565 students in West Wales and The Valleys (UKL1) are twice as important for the output of the region than the 207,940 of Inner London – West (UKI3).

Table 4 - Number of students and total contribution to the region

Ranking	Region Code	Region Name	Number of Students	Total contribution	% of Regional Output
1	UKI3	Inner London - West	207,940	5,020.39	1.58%
2	UKG3	West Midlands	161,270	4,297.04	3.54%
3	UKM7	Eastern Scotland	104,565	2,810.67	2.79%
4	UKD3	Greater Manchester	100,995	2,761.59	2.38%
5	UKE4	West Yorkshire	91,320	2,368.34	2.51%
6	UKK1	Gloucestershire, Wiltshire and Bristol/Bath	88,865	2,429.77	1.98%
7	UKF1	Derbyshire and Nottinghamshire	82,480	2,099.28	2.46%
8	UKL1	West Wales and The Valleys	74,565	1,858.42	3.00%
9	UKF2	Leicester, Rutland and Northampton	72,390	1,871.28	2.36%
10	UKJ2	Surrey, East and West Sussex	72,385	1,968.75	1.38%
11	UKI4	Inner London - East	72,160	1,777.90	1.06%

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[7] Using a range of sources on average student spend provides us with an estimate of approximately £20,000 split into £5,000 living costs, £6,000 accommodation costs and £9,000 education costs.

12	UKM8	West Central Scotland	71,980	1,904.73	3.04%
13	UKJ1	Berkshire, Buckingham and Oxford	71,330	1,849.68	1.18%
14	UKH1	East Anglia	69,555	1,860.28	1.71%
15	UKC2	Northumberland and Tyne and Wear	67,185	1,705.73	3.00%
16	UKJ3	Hampshire and Isle of Wight	67,180	1,761.25	1.85%
17	UKE3	South Yorkshire	60,405	1,483.68	3.25%
18	UKD7	Merseyside	58,455	1,461.69	2.62%
19	UKD4	Lancashire	51,465	1,291.39	2.20%
20	UKN0	Northern Ireland	50,725	1,248.24	1.76%
21	UKI7	Outer London - West and North West	49,680	1,271.45	1.09%
22	UKK4	Devon	48,860	1,240.75	2.98%
23	UKL2	East Wales	48,120	1,227.48	2.37%
24	UKH2	Bedfordshire and Hertfordshire	41,555	1,054.95	1.17%
25	UKC1	Tees Valley and Durham	36,705	900.37	2.25%
26	UKJ4	Kent	35,020	939.89	1.31%
27	UKG2	Shropshire and Staffordshire	30,525	757.08	1.27%
28	UKM5	North Eastern Scotland	26,900	597.35	1.64%
29	UKE2	North Yorkshire	25,075	638.92	1.94%
30	UKK2	Dorset and Somerset	22,610	596.74	1.21%
31	UKI5	Outer London - East and North East	21,335	520.51	0.88%
32	UKI6	Outer London - South	17,630	439.59	0.91%
33	UKF3	Lincolnshire	17,225	408.01	1.68%
34	UKE1	East Yorkshire and Northern Lincolnshire	15,585	367.79	1.01%
35	UKH3	Essex	15,565	401.70	0.59%
36	UKD6	Cheshire	15,410	373.28	0.66%
37	UKG1	Hereford, Worcester and Warwick	10,800	273.12	0.43%
38	UKM6	Highlands and Islands	9,325	218.26	1.01%
39	UKD1	Cumbria	7,580	174.74	0.80%
40	UKK3	Cornwall and Isles of Scilly	6,000	138.19	0.80%
41	UKM9	Southern Scotland	-	-	0.00%

Source: own elaboration using Higher Education Statistics Agency (HESA) data on HE student enrolments by HE provider in the academic year 2017-2018

Discussions & Conclusions

Universities can be a catalyst for the socio-economic fortunes of their local areas in a multitude of ways ranging from the creation of knowledge and the supply of skilled labour to increasing local demand via institutional and student expenditure. Whilst absorptive capacity has been considered a key for the innovation & labour supply channels, expenditure has until now been expected to benefit places homogenously.

Our paper challenges this idea by proposing a symbiotic relationship between student spending and the capacity of regions to benefit. We build the first MRIO

model for the UK, to simultaneously consider the impact of student spending in different regions. The model allows us to identify both the direct and indirect effects of an average student £1 spent.

We find significant heterogeneity in the direct and spillover effects across NUTS2 regions in the UK. Regions differ across their own and country effects, the spillovers they generate and receive, as well as the number of students they host. These produce a variable spatial footprint of student expenditure impacts.

The largest direct effects are 3.5 times the size of the smallest ones whilst the majority of spillover effects are directed and generated in London. When considering the actual size of the impacts, it is evident that student expenditure is more important in some places than others. These results point to the imbalance that is endemic in the economic geography of the UK (MCCANN, 2016) and shed light to the mechanisms that fuel it.

The level of regional economic diversification and specialisation significantly determine the observed differences both in the direct and spillover effects. The former are higher in regions containing large conurbations and higher densities. Urban regions are benefiting more from student spending since they offer a wider range of industries that can match student demand at the local level. This results in higher direct multiplier effects.

However, specialisation still has a role to play. We identify that places with higher shares of agricultural production can retain larger shares of the multiplier effects they generate. This is also related to the specificity of student spending that mostly focuses on non-tradables (entertainment) and food and beverage products. Specialisation is also important for the spillover effects. The dominance of London

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in Finance and Real Estate allows it to be the centre through which a lot of the student expenditure flows which makes the regions of the capital both the largest recipients and generators of spillover effects.

In policy terms, the paper highlights the need to consider a region's capacity to benefit when measuring the impact of student expenditure. To maximise the benefits from student spending, local industrial strategies should provide for a wide, diversified economic base coupled with specialisations around the main student expenditure items. In addition, we highlight that increasing student numbers will have varying effects in different places and that some places would benefit more from achieving higher multipliers rather than plainly increasing their number of students.

Finally, our approach has specific limitations that guide our future work. The first next step is to calculate the different impacts on the local labour markets, in terms of employment generated but also the type of skills that are demanded by the sectors (directly and indirectly) in order to satisfy the students' demand. Additionally, it would be interesting to estimate the induced effects of the income generated to those households employed to meet this demand, since they will have a spending impact in the local economy as well. Distinguishing between the type of student (foreign or local) can also play a role to better understand the net increases in regional income due to the student consumption during the years they are in a HEI.

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