Higher Education Institutions and Regional Development: A Meta-analysis

Verena Peer and Marianne Penker

International Regional Science Review published online 14 May 2014
DOI: 10.1177/0160017614531145

Article

International Regional Science Review
1-26

DOI: 10.1177/0160017614531145
irsr.sagepub.com

Higher Education Institutions and Regional Development: A Meta-analysis

Verena Peer[1] and Marianne Penker[1]

Abstract

Higher Education Institutions (HEIs) and their relations to regional development have raised political expectations and scientific interest since the middle of the twentieth century. The high number of scientific surveys conducted calls for a meta-analysis that integrates multidisciplinary case study results. This secondary case survey analysis offers new insights into the scientific knowledge base on HEI-region relations. Knowledge gaps as well as uncertain, single and cross case verified knowledge could be identified. Whereas the unilateral HEIs' impacts on the region have been broadly analyzed, there still is little knowledge on how to improve the HEIs-region relations. The article discusses the role of HEIs, which—being initially perceived as mere location factor—evolved to an active actor in the regional innovation and governance system. The article furthermore offers recommendations for policy makers and practitioners on how to use the knowledge gained for the further development of the HEI-region relations but also how to deal with knowledge gaps and context-specific research results.

Keywords

Higher Education Institutions, regional development, meta-analysis, uncertain knowledge, unknowns, mode 2 research

[1] Department of Economics and Social Sciences, Institute for Sustainable Economic Development, University of Natural Resources and Life Sciences Vienna, Vienna, Austria

Corresponding Author:
Verena Peer, Department of Economics and Social Sciences, Institute for Sustainable Economic Development, University of Natural Resources and Life Sciences Vienna, Feistmantelstraße 4, 1180 Vienna, Austria.
Email: verena.peer@boku.ac.at

Introduction

Locating Higher Education Institutions (HEIs) in regions where they should spur regional development has been recognized as an important regional political "instrument" and raised various expectations from politicians and regional practitioners since the middle of the twentieth century. Florax (1992) has been one of the first to highlight the complexity of HEIs' impact on regional development, specifying political, demographic, economic, infrastructural, cultural, educational, and social impacts. Knowledge transfer, community services, and community engagement have been subsumed under the notion of the "3rd function" of HEIs that supplements research and teaching. Within the last decades, a move away from a mere economic perspective to a broader inclusion of noneconomic contribution of HEIs to regional development can be observed (Boucher, Conway, and Van der Meer 2003). This in turn is driven by changing policy paradigms and expectation on HEI's contribution to regional development (Chatterton and Goddard 2000).

Despite the extent of research, the knowledge is still fragmented. It lacks a meta-analysis that integrates multidisciplinary results, cross border, and cross-case experiences. This article aims to bridge this gap by reflecting on the evolving role of HEIs for regional development throughout the last fifty years and elaborates a knowledge basis on the verified scientific results. Thus, a review and analysis of English and German language literature covering the last fifty years is conducted. Following Chatterton and Goddard's (2000) argument on changing policy expectations (see previously), we derived political expectations regarding the impact of HEIs on regional development from European and Austrian strategic policy documents. This policy discussion does not only embed the following literature review in a broader societal discourse but also allows for the identification of knowledge gaps, that is, expectations not yet backed up with scientific evidence.

The overall approach and the methods of the meta-analysis are explained in the second section. The third section presents the various roles of HEIs in regional development based on the outcome of the analysis of policy documents and the literature review. The fourth section looks into the changing research perspectives on the role of HEIs in regional development over the last fifty years. The following discussion section compares our results on ambiguous knowledge and research gaps but also on the changing research paradigm regarding HEI-region relations with those of other authors. Based on the insights gained on the existing knowledge base, the article concludes with implications for decision makers and practitioners who intend to spur the regional development impact of HEIs.

Approach and Methods of the Meta-analysis

The overall approach to the meta-analysis of empirical research articles is presented in Table 1. The main purpose of this article is to establish a knowledge base on the role of HEIs in regional development, identifying cross-case verified knowledge, but

Table 1. Case Survey Analysis (own illustration, based on Newig and Fritsch 2009).

Stages of the case survey	Explanation	Result
1. Research question	How did the knowledge base on the role of Higher Education Infrastructure (HEIs) in regional development evolve over the last fifty years?	
2. Methodology and data bases	Case survey method based on a literature survey including journal articles, books/book chapters, and project/research reports	Selection of databases: Scopus/SciVerse Electronic Journals Library (EZB) of Viennese Universities Google Scholar
3. Case selection criteria	Original research publications English or German language Last fifty years Joint definition of Scopus search query as well as for the libraries and Google scholar	The search included the terms: (a) "University" OR "Higher education Infrastructure" AND (b) "Regional Development" AND ("location factor" OR "(regional) labor market" OR "knowledge transfer" OR "human capital" OR "innovation)"[a]
4. Collect case samples	Data gathering trough the different channels mentioned	Journal Papers: 242[b] Books/book sections: 37 Project / Research Reports: 33
5. Data cleaning	Review of the collected English and German literature according to a strong focus on the relation between HEIs and regional development and a substantial contribution to the knowledge base on the HEI-region relation	Exclusion of 210 articles that missed the regional perspective such as educational administration, business research, and law $N = 102$ (publications for further analysis)
6. Coding scheme	The coding scheme is developed on the basis of an analysis of strategic policy papers in Austria and the European Union.[c] The codes represent the main expectations of (regional) policy toward the impacts of HEIs on regional development	Thematic focus of the research on the HEI-region relation (see also the Political expectations and Empirical results regarding HEI-region relations sections):
	The elaborated codes are applied to the selected literature; multiple assignments per publication are possible, depending on the scope of the conducted research	1 = Relation between the location pattern of HEIs and educational behavior 2 = Role of HEIs as household-oriented and economy-oriented infrastructure 3 = Alignment of curriculum and regional labor market

(continued)

Table 1. *(continued)*

Stages of the case survey	Explanation	Result
		4 = Impact of HEIs on regional labor market and economy (demand oriented) 5 = Role of HEIs as knowledge producer and disseminator 6 = Migration behavior of graduates 7 = HEIs as incubators for innovation 8 = HEIs as actors in regional innovation systems
7. Statistical analysis	(a) Correlation analysis (Spearman's Rho rank-order correlation) is applied so as to identify correlating research topics (b) Longitudinal analysis looks into the number of publications and their topics as well as the changing sources over the last fifty years	See the Evolving number of publications section
8. Data synthesis and categorization of knowledge types	The knowledge gathered for each of the eight research foci was synthesized and categorized according to different types of knowledge	Regarding the HEI's role in regional development, the following types of knowledge were identified: Knowledge gaps still open (policy expectations not supported by scientific evidence) Uncertain knowledge (contradicting results) Single case knowledge Cross-case verified knowledge
Report results	See article	

Note: [a]ABS ("University" AND "Region" AND "Development") AND DOCTYPE(ar) AND SUBJAREA (mult OR arts OR busi OR deci OR econ OR psyc OR soci) AND (higher education infrastructure).
[b]"University" OR "Higher education Infrastructure" AND "Regional Development" = 180; "University" OR "Higher education Infrastructure" AND "Regional Development" AND "location" = 12; "University" OR "Higher education Infrastructure" AND "Regional Development" AND "location factor" = 2; "University" OR "Higher education Infrastructure" AND "Regional Development" AND "labor market" = 5; "University" OR "Higher education Infrastructure" AND "Regional Development" AND "knowledge transfer" = 4; "University" OR "Higher education Infrastructure" AND "Regional Development" AND "human capital" = 8.; "University" OR "Higher education Infrastructure" AND "Regional Development" AND "innovation" = 31.
[c]"Europe 2000—Outlook for the development of the community's territory" (COM[90] 544), the "European Spatial Development Perspective (ESDP)," the "Gothenburg Strategy" COM(2002) 82, the "Lisbon Strategy" COM(2002)14, the EU2020 strategy, the Austrian Spatial Development Perspective "OEREK" 1981, 1991, 2001, and 2011 have been investigated.

also ambiguous results and knowledge gaps, that is, policy expectations not yet backed up by empirical research results. The research design helps to reveal need for future research, as well as some implications for practitioners and decision makers who want to spur regional development. The methods for the different steps of analysis are presented in three subsections.

Political Expectations as Coding Reference

An investigation of policy documents provided the coding categories for the meta-analysis of the research papers. This policy analysis, however, also confirmed that societal expectation on HEI's role in regional development changed over the last fifty years (Chatterton and Goddard 2000). As a source of information regarding political expectations, the "Europe 2000—Outlook for the development of the community's territory" (COM[90] 544, EC 1990), the "European Spatial Development Perspective (ESDP, EC 1999)," the "Gothenburg Strategy" (COM [2002] 82 EC 2002b), the "Lisbon Strategy" (COM[2002a]14, EC 2002a) as well as the EU2020 strategy (EC 2010) have been investigated. In Austria, the Austrian Spatial Development Perspective "ÖRK" 1981 (Wolf-Wicha 1982) and "OEREK" 1991, 2001, and 2011 (Österreichische Raumordnungskonferenz [ÖROK] 2002, 2011, 1992) as legally nonbinding document forming a policy framework for regional development on the national level was examined. The review of the political expectations revealed eight major topics of HEI-region relations: (1) location patterns of HEIs and the influence on the educational behavior of the regional population, (2) curriculum of HEIs and the regional labor market, (3) HEIs as household-related and company-oriented location factor, (4) impacts of HEIs on the regional economy, (5) knowledge production and dissemination by HEIs, (6) highly qualified graduates and their migration behavior, (7) HEIs and the regional innovation ability, and (8) HEIs within the regional innovation system. These categories provided the codes for the subsequent literature analysis and can be found again in the results section (see also Table 1).

Literature Survey

Research on HEI-region relations is dominated by case study designs. They allow for in-depth region-specific investigations of the impacts of HEIs on regional development, but at the same time they often lack the generalizability of the findings for the wider scientific discussion. In the present article, the methodological approach of the "case survey method" (Newig and Fritsch 2009) is applied. It offers the possibility for a systemic and rigorous synthesizing of previous case-based research, taking account of the richness of single case studies but at the same time allowing for a much wider generalization. This method of secondary analysis originates from public policy analysis and has been further developed in organizational research and management science (Lucas 1974; Yin and Heald 1975). By applying the case-

survey method to the topic of the HEI-region relations, we are able to clearly specify the empirical basis of the further analysis. With this reproducible approach, we can identify research gaps and also track demand for future research on the HEI-region relations. Table 1 summarizes the procedure of the literature review including the selection criteria as well as the steps of quantitative and qualitative analysis.

Quantitative and Qualitative Meta-analysis

A longitudinal analysis of the English and German language literature looks into the number of publications and the changing topics over the years as well as the changing sources of publication. Some publications focus on a couple of HEI-region relations while other surveys draw the attention on one specific aspect of the HEI-region relation. This is analyzed by a correlation analysis (see Table 1 and the Evolving Number of Publications section).

A further qualitative analysis looks into the different types of knowledge established over the last fifty years. The analysis differentiates between "knowledge gaps," "uncertain knowledge," "single case knowledge," and as well as "cross-case verified knowledge." This categorization is based on the following definitions:

(a) "knowledge gaps" subsume policy expectations which have not yet been backed up by empirical research;
(b) "uncertain knowledge" classifies contradictory research outcomes on the same topic;
(c) "single case knowledge" includes scientific results which have been achieved within individual case studies, thus the research outcome can be assumed to be valid under consideration of the case-specific framework conditions;
(d) "cross-case verified knowledge" comprises scientific outcomes confirmed by more than two studies.

Empirical Results Regarding HEI-region Relations

The following section presents the eight areas of societal interest as identified from the strategic policy documents and illustrates them with scientific literature.

Location Patterns of HEIs and Educational Behavior of the Regional Population

The decentralization of higher education infrastructure raises the expectation that a higher proportion of the regional population will participate in educational opportunities, which again should promote regional development opportunities. In the literature, the geographical distribution of HEIs—justified by equality arguments—dominated the discourse in the 1950s and 1960s (e.g., Robbins Report 1963; Boucher, Conway, and Van der Meer 2003). Later, the decentralization of HEIs is

mainly associated with regional economic competitiveness (Dearing Report; Boucher, Conway, and Van der Meer 2003). Charles (2001) mentions the example of the University of Joensuu, which has been established explicitly to accelerate the social and economic progress of eastern Finland. International comparisons show that location patterns vary from country to country. Countries with a centralist government generally have a highly concentrated distribution of HEIs (e.g., Ireland and Greece), while a federal structure (like in Germany) rather results in a disperse distribution. Germany is a good example for a purposeful regionalization of HEIs. That led to a widely distributed location pattern of HEIs in regions, which previously lacked any HEI before (Kunzmann and Tata 2000). Within the same period, Finland, too, enlarged the number of HEIs in rural areas with the specific mission of encouraging greater participation and access to higher education (Holtta and Malkki 2000). Complex location patterns (Spain and the United Kingdom) are explained as a result of an educational policy which unified the tertiary and postsecondary sector (Armstrong and Darral 1997; Boucher and Wikham 2000; Charles 2001). In the 1960s, the United Kingdom experienced a rapid expansion of HEIs due to the "Robbins Report" (Armstrong and Darral 1997; Charles 2001).

What effects of decentralization can be empirically verified? Geipel (1970), Peisert (1984), Mayr (1979), Geißler (1965), Rolfes (1996), and Kunzmann and Tata (2000) reveal that the regionalization of HEIs results in more regional inhabitants considering participating in higher educational programs. Bühler-Conrad (1985), however, conducted a survey in several Swiss regions and revealed that spatial proximity does not entirely change the educational behavior of a certain social "class." Both, the spatial as well as social accessibility are relevant (Meusburger 1998). The latter is determined by the social status of the parents (Meusburger 1998) or by the information available regarding cost and benefits of higher education (Connor 2001). Gensch (1980) and Lassnigg et al. (2003) highlight that the mere number of students does not guarantee the fulfillment of regional development expectations. It requires certain regional preconditions such as regional economic power, the absorptive capacity of the labor market, or the regional innovation potential (Delapina, Holzinger, and Schausberger 2001).

Curriculum of HEIs and the Regional Labor Market

The policy intention behind an effective alignment of educational content and the requirements of the regional labor market is to satisfy the demand of the regional labor market as well as to develop adequate employment opportunities for the highly qualified graduates, preventing them from outmigration (ÖROK 2002, 79). The literature analysis shows that pioneers in decentralized HEIs, such as the Civic Universities in the United Kingdom and the Land Grant Universities in the United States tried to link academic excellence with the regional needs of agricultural and subsequently industrial development (Goddard and Vallance 2011). Finnish Universities, which became the cornerstones in the revival of the Finnish economy in the 1990s,

are seen as a more recent best practice example (Boucher, Conway, and Van der Meer 2003). With a similar hope of supporting regional economic development, "Universities of Applied Sciences" have been established in rural areas of Austria, Germany, and Switzerland in the 1960s but also 1980s and 1990s. Sometimes regional job markets (foremost in rural areas), however, do not evolve in parallel to the new HEIs and thus lead to a "forced" outmigration of young well-educated inhabitants (Fromhold-Eisebith 1992; Meusburger and Schmidt 1996; Rolfes 1996). On the other hand, too much alignment of educational and regional demand can also block new development impulses. It leads to a "lock-in" situation where new innovative development directions cannot be implemented (Lassnigg et al. 2003).

HEIs as a Household-related and Company-oriented Location Factor

Both in the policy documents and in the surveyed literature, the role of HEIs as a location factor for private households, providing cultural and leisure activities as well as buildings for multiple use on one hand and as location factor for businesses on the other hand are emphasized. HEIs are discussed as a contributor to the location quality, mostly under the term "3rd role of HEIs" (Blume and Fromm 2000; Fischer and Wilhelm 2001; Fischer and Nef 1990; Florax 1992; Franz, Rosenfeld, and Roth 2002). Although it mostly is the third role of community services, which embeds HEIs in their region (Chatterton and Goddard 2000), empirical scientific evidence concerning these effects on the location quality is still rare. From a private household perspective, HEIs provide (a) information and educational services, (b) infrastructure, and (c) strengthen the cultural resources of the region (Bauer 1997; Böhret 1985; Charles and Benneworth 2001; Lassnigg et al. 2003). Several, mostly geography studies shed light on the HEIs' impacts on the housing market (Mayr 1979; Peisert 1975; Schramm 1980; Willauschus 1979). Mayr (1979) shows for German cities that HEI locations are often not prepared for the demand for students' and staff's housing. That often leads to undesired commuter traffic. Fischer and Nef (1990), among others, look into the effects of HEIs on the business location, focusing on the attraction of new businesses, investors, and immigration of a qualified labor force. HEIs attract science and technology companies (Boucher and Wikham 2000; e.g., Limerick in Ireland) and knowledge-based businesses (in the peripheral Ruhr region in Germany; Kunzmann and Tata 2000). Van der Meer and Groenefelt (2000) reveal outstanding impacts of the Dutch University of Twente on regional entrepreneurship.

Impacts of HEIs on the Regional Economy

The political expectations regarding the impact of HEIs on the regional economy range from a diversification (Wolf-Wicha 1982) or the promotion of the regional economic potentials (ÖROK 2002) to the strengthening of the regional competitiveness (ÖROK 2011). The subsequent summary of the literature analysis focuses

mainly on the demand-oriented, direct regional economic effects due to the construction and operation of HEIs (Boucher, Conway, and Van der Meer 2003; Drucker and Goldstein 2007) while the supply-oriented and the network effects are dealt with in the chapter Knowledge Production and Dissemination by HEIs as well as HEIs within the Regional Innovation System. These direct economic impulses triggered by the HEI's demand for goods and services (Binsfeld and Müller 1984; Engelbrech, Küppers, and Sonntag 1978; Fürst 1984) attracted major scientific interest. Most of the studies have been conducted as single case studies applying input–output analysis or multiplier analysis (Baer 1976; Woll 1966). Only few general outcomes can be deduced: (a) concerning the demand for personnel, the surveys prove outstanding employment effects (Benson 1997; Clermont 1997; Oser and Schröder 1995; Pfähler 1997; Schäfer and Leithauser 1992; Strauf and Scherer 2008; Voigt 1995) and (b) concerning expenditures for construction work, material and capital, direct regional sales effects have been proven (Blume and Fromm 2000; Franz, Rosenfeld, and Roth 2002; Leusing 2007). An economically relevant stimulus also results from the students, mostly from their impact on the housing market, gastronomy, cultural events, demand for daily goods, and services (Spehl, Feser, and Schulze 2005).

Knowledge Production and Dissemination by HEIs

"Knowledge" is recognized as *the* central strategic resource for regional development in the late 1990s. This led to an increased attention on HEIs as organizations, stimulating the production and transfer of knowledge. Research activities attracted political attention, as they are associated with an enhanced innovation capability and competitiveness of the region (ÖROK 2011). Scientists define HEIs as significant institutional "players" in knowledge-based regional development (Benson 2000; Thanki 1999), or as "knowledge factories" (Uyarra 2010). Due to the recent shift from the homogeneous, linear and hierarchal "Mode 1" concept to the transdisciplinary, heterogeneous, heterarchical, and transient "Mode 2" concept of knowledge creation (Arbo and Benneworth 2007; Nowotny, Scott, and Gibbons 2003), HEIs have no longer the monopoly on knowledge production, but enter into complex strategic alliances and cooperative networks with other knowledge producers (Chatterton and Goddard 2000). Spin-offs as a special type of start-up play a central role as diffusion channel for knowledge and technology. The survey conducted by the Centre for European Economic Research (ZEW 2002) reveals that two of three spin-offs are situated in close proximity to their incubator. Apart from financial reasons, the main obstacles for the foundation and success of spin-offs are the lack of a qualified labor force and the passivity of the regional economy (Fromhold-Eisebith and Nuhn 1997; ZEW 2002). The success of spin-offs seems to depend on various regional, institutional, organizational, and individual characteristics, as well as on the nature of knowledge transferred (Döring and Schnellenbach 2006; O'Shea, Chugh, and Allen 2008; Pirnay, Surlemont, and Nlemvo 2003). While there are several studies confirming the importance of knowledge transfer via spin-offs or

graduates, the discussion on suitable indicators to measure nonpersonal knowledge transfer is controversial. Patent applications, amount of external funding, scientific theses, and publications are the most frequently used indicators (Blume and Fromm 2000; Sauerborn 2005; Spehl, Feser, and Schulze 2007). Educational and research contents matching the actual demand of regional firms is seen as a core element for the strengthening of knowledge coproduction and exchange between HEIs and regional businesses (Benson 2000; Fürst and Back 2011; Pfähler 1997; Rosenfeld and Roth 2004). Boucher, Conway, and Van der Meer (2003) add that human assets, cultural factors, and the so-called social fabric of the region may explain differences between regions regarding their potential to interact with, and benefit from, HEIs.

The Migration Behavior of Highly Qualified Graduates

Within the scientific discourse, the migration behavior of highly skilled graduates and the factors influencing it attract wide-ranging, multidisciplinary interest. Micro-level studies show, for example, that the choice of the study subject has major influence on regional mobility, with graduates from technical studies having a greater willingness to move compared to graduates from social and health care studies (Mohr 2002; Rolfes 1996). Furthermore, those students, who find a studying possibility within their native region, have been proven to also be rather immobile after their graduation (Falk and Kratz 2009; Mohr 2002; Rolfes 1996; Webler 1983). Rational decisions based on the perceived employment opportunities as well as on expected income are in the focus of several studies (Armstrong and Taylor 2000; Benson 2000; Charles and Benneworth 2001; Chilla, Morhardt, and Braun 2008; Fabian and Minks 2008; Sjaastad 1962). Recent approaches also consider aspects of "place utility" and "amenities" (Bähr 2010; Fabian and Minks 2008; Florida 2002). Macro-perspective surveys seek to explain mobility via external push and pull factors (unemployment rate, gross domestic product [GDP], per capita income, etc.; Akademie für Raumforschung und Landesplanung [ARL] 1994; Hoffmann-Nowotny 1970; Ravenstein 1972). Furthermore, there are several integrative studies on the underlying causes of "brain drain" pointing out that for example the information on labor market opportunities provided by HEIs to their graduates is one influential factor (Beaverstock 1994; Gardner 1981; Meusburger and Schmidt 1996; Rolfes 1996; Schmidt 1996; Weichhart 1993).

HEIs and Regional Innovation Ability

The role of HEIs in enhancing the regional innovation ability (Frey and Brugger 1984; Fritsch and Schwirten 1999; Moulaert and Sekia 2002) and the technology orientation of small and medium enterprises (Glatz and Scheer 1981) are also of major scientific interest. Fritsch and Schwirten (1999) stress that the contribution of HEIs to private sector innovation is primarily related to the early stages of innovation processes, such as the generation and development of new ideas. Another function of HEIs is seen in their role as an "aerial" (Fritsch et al. 1998; Fritsch and

Schwirten 1999), absorbing knowledge from outside the region and making it available for innovation processes in the region. Although the support for innovation in business is perhaps the least controversial area of HEIs from a policy perspective (Asheim, Smith, and Oughton 2011), the understanding of the factors determining the impact of HEIs on the regional innovation system is still incomplete (Arbo and Benneworth 2007). However, proximity between firms and HEIs as well as a regional culture of cooperation are interpreted as the crucial factors of success, often surveyed under the term "Cluster."

HEIs within the Regional Innovation System

In the literature of the mid-1990s, the concept of regional innovation systems emerged, focusing on innovation as a creative process based on collective learning (on a formal or informal basis) rather than a direct outcome of research activities (Cooke, Uranga, and Etxebarria 1997; Moulaert and Sekia 2002; Tödtling, Lehner, and Trippl 2007), thus being dependent upon the presence of different actors and their willingness to cooperate (Moulaert and Sekia 2002; Organization for Economic Cooperation and Development [OECD] 2003). HEIs are regarded as an active stakeholder, being able to shape network topologies (Benneworth et al. 2009). Gunasekara (2006a) looks into the role of HEIs in the development of regional innovation systems. Regional innovation systems are discussed as being socioculturally embedded and path-dependent (Autio 1998), with agglomerations often having advantages over rural areas (Cooke, Uranga, and Etxebarria 1997; Maier, Tödtling, and Trippl 2006).

Longitudinal Analysis of the Evolving Role of HEIs in Regional Development

Whereas the previous section presents an overview on societal expectations and scientific knowledge regarding the various aspects of the HEI-region relations, the following analysis looks into the changing number of publications as well as the research perspectives on the roles of HEIs with regard to regional development over the last decades. The literature analysis helps to shed some light on the evolving role of HEIs in regional development.

Evolving Number of Publications

Figure 1 shows the research priorities of the 102 publications which have been included in the literature review according to their publication date. If a scientific publication focuses on several topics, it has been quoted several times due to the different topics dealt with. Figure 1 illustrates the fast growing number of publications in this field of study. In the 1990s, the number of publications literally multiplied. Not only the number of articles but also that of topics increased. Particularly in the last two decades, new topics emerged, without displacing older ones.

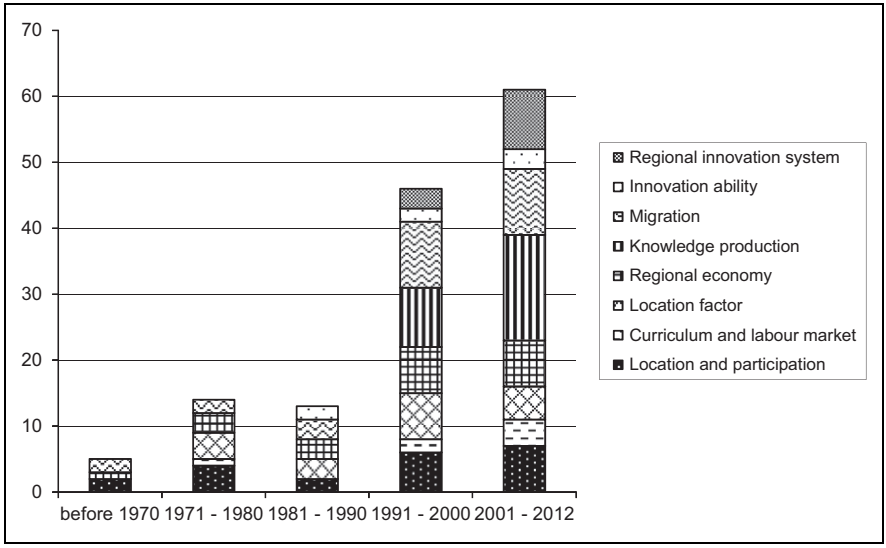

Figure 1. Changing number of scientific publications on HEI-region interaction (number of articles categorized according to the year of publication and main topic; own illustration).

Regarding the different types of publications (see Figure 2), books and book chapters are dominating until the 1980s, followed by research/project reports. Journal articles are the prevailing publication type of the last decade and make the majority of research articles included in the analysis.

A statistical analysis (Spearman's Rho rank-order correlation) is applied, so as to identify correlating research foci. The analysis reveals slightly positive correlations between those surveys that focused on the location pattern of HEIs and the alignment between the curriculum of HEIs and the regional labor market (0.245*). At the same time, negative correlation occurred between the focus on the role of HEIs as knowledge producer and disseminator and the location pattern of HEIs (−0.259**); between the focus on the migration behavior of graduates and the impact of HEIs on the regional labor market and the regional economy (−0.285**); between the location pattern of HEIs and the investigation of impacts on the regional labor market and economy (−0.236*). These results awaken the impression that the undertaken research is not only based on region-specific case studies but also reduced to certain perspectives, often lacking an integrative view (* denotes significance at the .05 level and ** denotes significance at the .001 level).

Changing Roles of HEIs for Regional Development

Research on HEIs until the early 1980s emphasized the location of HEIs and their role in reducing regional disparities and ensuring equal living conditions (Arbo and Benneworth

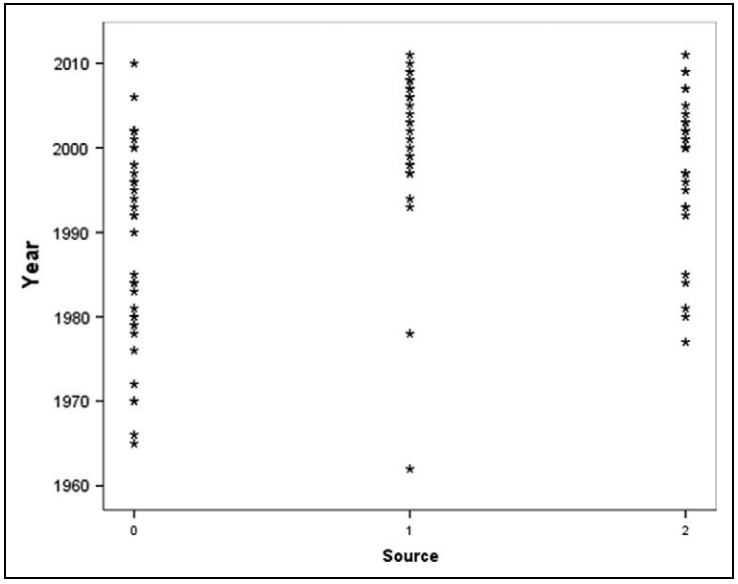

Figure 2. Different sources have been investigated (0 = book/book chapters; 1 = journal articles; 2 = project/research reports).

2007; Gerhardter and Gruber 2001; Robbins 1963). In the 1950s and 1960s, this expectation on HEIs led to a decentralization of HEI infrastructure in various European countries.

From the 1980s onward, the scientific interest shifted to the impacts of HEIs on the regional labor market emphasizing supply-oriented effects (instead of the previous focus on demand-oriented impacts) and their effect as a location factor for businesses. Two further research topics emerged in this period: the migration behavior of graduates and an emerging scientific interest in the effect of HEIs on the regional ability to innovate. Comparing German and English language literature, the main research focus of the latter has been directed on the migration behavior of the graduates. German language publications on the other hand focused on the impacts on economic development or the incubator effect for regional innovation.

In the 1990s, research on HEIs literally multiplied in terms of publication quantity, covering already all eight topics identified in the analysis of policy documents. If at all, research interest diminished regarding the decentralization/centralization debate of HEI-location, impacts on the location quality and the match but also mismatch between curriculum and regional labor market demands. Research in various disciplines focused on HEI-related knowledge transfer, HEIs as a knowledge producer and disseminator, the migration behavior of graduates as part of the HEIs person-bound knowledge transfer, the role of HEIs as incubator for innovation as well as—in few emerging publications—their role within the regional innovation system.

In the last decade, we still see a growing number of research work done on HEIs. The research focused on HEIs as knowledge producers and disseminators, the migration behavior of graduates as well as the emerging topic of the HEI's role within the regional innovation system. Earlier topics, such as the location of HEIs, demand- and supply-oriented effects lost much of their previous scientific attention. The English literature focused on the migration behavior of graduates, the function of HEIs as incubators for innovation as well as on their role within the regional innovation system. Research published in German looked into the impacts of HEIs on the regional labor market and economy (although with a new interest in supply-oriented effects) into HEIs as knowledge producer or disseminator and only partly into the migration behavior of graduates. "Innovation" as research subject was mainly emphasized in English language literature.

Discussion

The literature analysis provided a rich source of information. Despite the efforts taken, such an analysis can never be exhaustive. More specifically, the authors faced major challenges in accessing older English language literature. Literature published in other languages had been absolutely excluded from the analysis. This limitation has to be considered, when interpreting and discussing the results.

Discussion of the Types of Knowledge

The synopsis of multidisciplinary research reveals cross-case evidence on how the accessibility of HEIs enforces the participation in higher education. There is also broadly confirmed knowledge of the positive effects on the regional labor market and regional economy. This is confirmed by Cerych (1980), who also compiled a selection of outcomes regarding scientific attempts to measure and evaluate these economic effects (Cerych 1980). Especially, evaluations of new foundations of HEIs—which have been created numerously throughout Europe in the 1960s—came into vogue, as under a weak financial situation of the public sector they had to prove their profitability (Cerych 1980; Fürst 1984). Also a considerable impetus for the attractiveness of the region as a commercial location as well as provider of cultural facilities has been proven through various surveys. Although Boucher, Conway, and Van der Meer (2003) argue that there is not much scientific evidence which can be generalized regarding the migration patterns of graduates and the factors influencing it, we identified several studies documenting perceived employment opportunities and expected income as main driving forces. Single case studies cover knowledge dissemination as well as HEI-related spin-offs. Uncertain knowledge occurs mainly regarding the effects of HEIs on location decisions of households and on the factors influencing the cooperation culture between HEIs and the regional economy. The policy expectation of HEIs as an incubator for regional innovation is also confronted with contradictory results. This confirms Arbo and Benneworth (2007) who

conclude that the outcomes of surveys dealing with the regional ability to innovate are rather ambiguous: collaboration being important, but so too seems to be rivalry; close ties being important, but so are global networks; nonhierarchical open structures and on the other hand authoritative hierarchies.

The comparison of societal expectations as documented in strategic policy documents with the scientific knowledge base supported the identification of research gaps. The link between HEIs and the regional identity, HEI's potential to enhance the innovation ability, particularly regarding social and ecological challenges are pointed out in policy documents but are only scarcely touched by regional development research. Furthermore, we know little about those factors determining the regional absorptive capacity: most scientific research focused on the HEIs and their effects, not surveying region-specific implementation capacity and absorbency. This gap has also been identified by Arbo and Benneworth (2007) and Fürst and Back (2011).

Only recently, the engagement of HEIs within the regional governance system has been addressed, both in scientific literature (Zellweger, Sieger, and Halter 2011) and in policy documents (see, e.g., Europe 2020).Charles and Benneworth (2001) identified four areas in which HEIs, mainly universities directly contribute to the regional governance system: (a) representing own interests, for example, in the area of planning and land use practices, (b) selling governance support services, for example, consultancy services and expertise to support regional governance networks, (c) entrepreneurial activities by HEIs themselves, and (d) supporting communities of "good citizens," in the sense of HEI's employees having a propensity to "join up" professional and other networks. This also implies a change from an organization formerly indirectly contributing to regional (economic) development to a more proactive role (Uyarra 2010). Literature on the "engaged university" (Chatterton and Goddard 2000; Gunasekara 2006a; Uyarra 2010) or "sustainable university" (Adomssent and Michelsen 2006; Barth 2011; Cortese 2003; Filho 2011; Lozano 2006; Velazquez 2006) add to the economic focus of the past with a social, cultural, and ecological perspective and focus, for example, on barriers and opportunities of HEIs to engage and be actively involved in their region (Arbo and Benneworth 2007; Zellweger, Sieger, and Halter 2011).

Furthermore, the literature analysis revealed:

- a focus on the short- and middle-term impacts of HEIs on regional development with nearly no investigations having a long-term perspective;
- a shortage in process-oriented, dynamic approaches compared to the major focus on static effects;
- an emphasis on unilateral supply- and demand-oriented effects of HEIs on the region with rare consideration of the two-way interaction of HEI and region, patterns of interaction, co-learning, and the coproduction of knowledge and innovation in a joint effort of HEI, businesses, nongovernmental organizations (NGO)s and other players of the regional innovation system.

The ambiguity of knowledge and the extent of single case evidence on the impacts of HEIs might be explained by two arguments: uniqueness and context-specificity of HEI-region relations (Fürst 1984; Fürst and Back 2011), various time scopes of the research conducted, often being inconsistent with the long-term nature of many HEI impacts and the complexity of regional systems.

Discussion of Shifting Research Priorities

The longitudinal analysis of fifty years of research on HEI-region relations yielded interesting insights on shifting research perspectives. The growing body of literature on HEI-region relations was characterized by changing priorities that can be basically linked to different roles of HEIs in regional development. Up to the 1980s, HEIs were conceptualized as an instrument for reducing regional disparities, in the 1990s rather as an instrument for enhancing regional endogenous potential. In the last decade of the twentieth century, HEIs were analyzed and seen as a knowledge factory and knowledge disseminator which changed in the last decade to a conceptualization of HEIs as incubators for innovation. The shift of research and policy priorities which are reflected in these changing roles can be discussed within the context of a more general change of paradigm to the so-called mode 2 or postmodern science and more specifically with a shift from linear to more systemic models to innovation, for example, the Triple Helix model of university–industry–government relations.

The mode 2 concept of knowledge production (Gibbons et al. 1994; Nowotny, Scott, and Gibbons 2003; Nowotny, Scott, and Gibbons 2001) or "post-normal science" (Funtowicz and Ravetz 1993) is characterized by problem orientation, contextualization, as well as knowledge production, knowledge integration, and quality management as cooperative task of scientists and society, that is, shared accountabilities (Bammer 2005; Hirsch Hadorn 2008; Klein 2001; Nowotny, Scott, and Gibbons 2003; Pohl and Hirsch Hadorn 2007). A very similar, however more specific concept is the Triple Helix model of university–industry–government relations. As opposed to past linear and hierarchical innovation models, it conceptualizes innovation as an outcome of recursive overlaps of interactions and negotiations among university, industry, and government (Etzkowitz and Leydesdorff 1997; Gunasekara 2006b, 2006a) and feedbacks on institutional arrangements (Leydesdorff and Meyer 2003).

The more general "mode 2" paradigm of science as well as the more specific Triple Helix model of university industry government relations goes beyond the linear and hierarchical model of innovation. This shifting paradigm is mirrored in research and policy priorities on HEI-region relations. In the 1960s until the 1980s, HEIs where interpreted as regional political instruments and thus as part of the regional infrastructure, providing the region with educational programs and research outcomes as well as giving impetus to the regional economy. This is in line with the hierarchical linear innovation models of this time. HEIs were conceptualized as unchallenged repositories of particular forms of privileged information

(Arbo and Benneworth 2007). This "mode 1" type of knowledge production was characterized by the hegemony of theoretical or experimental science and the autonomy of the scientist (Goldstein 2010). Consequently, policy and science focused on the unilateral impact of HEI on regional development. Within the new paradigm of "mode 2" science or the Triple Helix model, knowledge is coproduced by science and society and innovation a collective process, taking place among different actors (Arbo and Benneworth 2007). It cannot be a pure coincidence that in the same period new roles were assigned to HEIs by science and policy: they should become active actors within the regional innovation system or incubators for regional innovation (Caniels and Van der Bosch 2011; Fritsch and Schwirten 1999; Fritsch and Slavtchev 2005; Leusing 2007; Sauerborn 2005; Spehl, Feser, and Schulze 2007; Spehl, Feser, and Schulze 2005). They are seen as important actors within the interactive process of regional development (Arbo and Benneworth 2007; ÖROK 2002), as fulfilling a facilitating, boundary spanning, and networking role (ÖROK 2011; Uyarra 2010), also including entrepreneurial activities (Karlsson and Zhang 2001).

This new perspective on HEIs as players in regional (innovation) systems resulted in research priorities shifting from "What" to "How," from the system knowledge to the transformation knowledge, as Hirsch Hadorn (2008) would call it in the context of "mode 2" science:

- system knowledge on the structures and processes underlying HEI-region relations explaining cause and effect relations (most of the research covered by the literature analyzed, i.e., the "what");
- target knowledge on norms and values for the intended or wished for HEI-region relations (as e.g., illustrated by the analysis of strategic policy documents);
- transformation knowledge on possible means of altering HEI-region relations by changing existing practices and introducing desired ones (there is still little transformation knowledge documented in literature).

Thus, the role of HEIs within regional development evolved from a mere education infrastructure, to a regional actor that actively interacts with regional stakeholders and shapes regional development paths.

Conclusions for Practitioners

In this analysis, we attempted to generate a cross-case and multidisciplinary knowledge base on HEI-region relations. An analysis of policy documents as well as a longitudinal analysis of research outcomes highlighted evolving perceptions of the role of HEIs in regional development. Some societal expectations are well supported by cross-case verified knowledge. However, there are also linkages between HEIs and their surrounding regions which are confronted with ambiguous

results and knowledge gaps. This results in two main challenges for decision makers and practitioners who want to improve the interplay of HEIs and their surrounding region. The first is to deal with those areas, where scientific knowledge is still uncertain such as the role of HEIs for the establishment of cooperation and network structures, the impact of HEIs in supporting the regional economy with highly qualified graduates, impacts on the migration behavior of highly qualified graduates, the potential of HEIs to raise the regional innovation ability, and the ''new'' roles for HEIs in and for the region (e.g., ''entrepreneurial,'' ''engaged,'' ''sustainable'' university). The second challenge refers to the characteristics of the knowledge gained: many research outcomes and results are context-specific. As a result, HEI-region relations seem to be unique, being shaped by the specific internal structural characteristics of the region and the overriding cultural and political framework conditions as well as by the size, research focus, and study programs offered by the HEI itself. This context-specificity is mirrored by the case study approach as the prevailing research design applied in past research. Hence, practitioners have to be aware that HEIs will not spur regional development autonomously or inevitably, but that their regional effectiveness will depend on the regional absorptive capacity, the regional actors' willingness to cooperate, and other regional characteristics. Therefore, network and cooperation structures are crucial for the coproduction of knowledge between HEIs, businesses, public authorities, and civil society. This also includes the role of HEIs within the regional governance system.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

References

Adomssent, M., and G. Michelsen. 2006. ''German Academia Heading for Sustainability? Reflections on Policy and Practice in Teaching, Research and Institutional Innovations.'' *Environmental Education Research* 12:85–99.

Arbo, Peter, and Paul Benneworth. 2007. *Understanding the Regional Contribution of Higher Education Institutions*. OECD Publishing Working Papers No 9. Princeton, NJ: OECD.

ARL (Akademie für Raumforschung und Landesplanung), ed.. 1994. *Akademie für Raumforschung und Landesplanung. Handwörterbuch der Raumordnung*. Braunschweig, Germany: ARL Akademie für Raumforschung und Landesplanung.

Armstrong, H., and J. Darral. 1997. ''Maximising the Local Economic, Environmental and Social Benefit of a University: Lancaster University.'' *GeoJournal* 41:339–50.

Armstrong, H., and T. Taylor. 2000. *Regional Economics and Policy*. 3rd ed. Oxford, England: Malden.

Asheim, B., H. Smith, and C. Oughton. 2011. "Regional Innovation Systems: Theory, Empirics and Policy." *Regional Studies* 45:875–91.

Autio, E. 1998. "Evaluation of RTD in Regional Systems of Innovation." *European Planning Studies* 6:131–40.

Baer, P. 1976. "Die ökonomische Bedeutung der Universität Göttingen für Göttingen und Umgebung." *Neues Archiv für Niedersachsen* 25:305–14.

Bähr, Jürgen. 2010. *Bevölkerungsgeographie*. Stuttgart, Germany: Eugen Ulmer.

Bammer, G. 2005. "Integration and Implementation Sciences: Building a New Specialization. " *Ecology and Society* 10. http://www.ecologyandsociety.org/vol10/iss2/art6/ (accessed August 10, 2011).

Barth, M. 2011. "Towards a "Sustainable University": Scenarios for Sustainable University Development." *International Journal of Innovation and Sustainable Development* 5:313–32.

Bauer, E.-M. 1997. "Die Hochschule als Wirtschaftsfaktor. Eine systemorientierte und empirische Analyse universtitätsbedingter Beschäftigungs-, Einkommens- und Informationseffekte—dargestellt am Beispiel der Ludwig-Maximilians-Universität München." In *Münchner Studien zur Sozial- und Wirtschaftsgeographie*, edited by Verlag Michael, 178. Lassleben Kallmünz/Regensburg. München.

Beaverstock, J. V. 1994. "Re-thinking Skilled International Labour Migration: World Cities and Banking Organisations." *Geoforum* 25:323–38.

Benneworth, P., L. Coenen, J. Moodysson, and B. Asheim. 2009. "Exploring the Multiple Roles of Lund University in Strengthening Scania's Regional Innovation System: Towards Institutional Learning?" *European Planning Studies* 17:1645–64.

Benson, L. 1997. "Regionalwirtschaftliche Effekte der Universität Trier—Eine Untersuchung der Auswirkungen auf die regionale Wirtschaft während der Leistungserstellungsphase." *Material zur Planung Bd* 6.

Benson, Lutz. 2000. "Regionalwirtschaftliche Effekte von Hochschulen während ihrer Leistungsabgabe. Theoretische Analyse und methodische Überlegungen zur Empirie." In *TAURUS Materialien*, vol 7, 97. Trier, Germany: Univ., Geschäftsstelle.

Binsfeld, M., and A. Müller. 1984. *Regionalwirtschaftliche Analyse von Hochschulneugründungen—mit einer Anwendung auf die Universität Trier*. Trier, Germany: Diplomarbeit im FB IV, SRP der Universität Trier.

Blume, L., and O. Fromm. 2000. *Regionalökonomische Bedeutung von Hochschulen. Eine empirische Untersuchung am Beispiel der Universität Gesamthochschule Kassel*. Wiesbaden, Germany: Dt. – Univ.-Verl.

Böhret, Carl. 1985. "Hochschulen und ihr Umfeld. Erfahrungen und Erwartungen im Meinungsspiegel." In *Speyer Forschungsberichte* 81, Speyer, Germany: Forschungsinstitut für öffentliche Verwaltung bei der Hochschule für Verwaltungswissenschaften Speyer.

Boucher, G., C. Conway, and E. Van der Meer. 2003. "Tiers of Engagement by Universities in their Region's Development." *Regional Studies* 37:887–97.

Boucher, G., and J. Wikham. 2000. *UNIREG Shannon Regional Report*. Dublin, Ireland: Employment Research Centre, Trinity College Dublin.

Bühler-Conrad, E. 1985. "Auswirkungen von Maßnahmen zur Verbesserung des Bildungsangebotes - dargestellt am Beispiel von Mittelschulen und Berufsschulen." In *Auswirkungen von Infrastrukturinvestitionen. Empirischer Beitrag zur Erfolgskontrolle der Regionalpolitik des Bundes*, edited by Christian Hanser, 315–422. Grüsch, Switzerland: Verlag Rüegger.

Caniels, Marjolein, and Herman Van der Bosch. 2011. "The Role of Higher Education Institutions in Building Regional Innovation Systems." *Papers in Regional Science* 90:271–87.

Cerych, Ladislav. 1980. "Retreat from Ambitious Goals?" *European Journal of Education* 15:5–13.

Charles, David. 2001. *UNIREG Universities and Regional Development. Final Report*. Newcastle, New South Wales: Project funded by the European Community under the Targeted Socio-Economic Research (TSER).

Charles, David, and Paul Benneworth. 2001. *The Regional Contribution of Higher Education*. London, UK: HEFCE/Universities.

Chatterton, Paul, and John Goddard. 2000. "The Response of Higher Education Institutions to Regional Needs." *European Journal of Education* 35:475–96.

Chilla, Tobias, Tobias Morhardt, and Boris Braun. 2008. "Jenseits der Speckgürtel: Wanderungsabsichten von Schulabsolventen und der demographische Wandel im ländlichen Raum." *Raumforschung und Raumordnung* 3:260–70.

Clermont, Christian. 1997. "Regionalwirtschaftliche Effekte von Wissenschaftseinrichtungen - Theorie, Meßkonzepte und Ergebnisse für Hamburg." *Europäische Hochschulschriften - Reihe V: Volks- und Betriebswirtschaft Bd* 2180:136.

Connor, H. 2001. "Deciding for or against Participation in Higher Education: The Views of Young People from Lower Social Class Backgrounds." *Higher Education Quarterly* 55: 204–24.

Cooke, Philip, Mikel Gomez Uranga, and Goio Etxebarria. 1997. "Regional Innovation Systems: Institutional and Organisational Dimension." *Research Policy* 26:475–91.

Cortese, A. D. 2003. "The Critical Role of Higher Education in Creating a Sustainable Future." *Planning for Higher Education* 31:15–22.

Delapina, Franz, Elisabeth Holzinger, and Bernhard Schausberger. 2001. *Verfahren der Standortprüfung für Fachhochschulstudiengänge*. Wien, Austria: Österreichisches Institut für Raumplanung.

Döring, Thomas, and Jan Schnellenbach. 2006. "What Do We Know About Geographical Knowledge Spillovers and Regional Growth? A Survey of the Literature." *Regional Studies* 40:375–95.

Drucker, J., and H. Goldstein. 2007. "Assessing the Regional Economic Development Impacts of Universities: A Review of Current Approaches." *International Regional Science Review* 30:20–46.

EC (European Commission). 1990. "Europe 2000—Outlook for the Development of the Community's Territory." In *COM(90) 544*, edited by Commission of the European Communities. Brussels, Belgium: Commission of the European Communities

EC (European Commission). 1999. "European Spatial Development Perspective (ESDP)." Edited by European Commission. Potsdam, Germany: European Commission.

EC (European Commission). 2002a. "The Lisbon Strategy—Making Change Happen." In *COM(2002) 14*, edited by Commission of the European Communities. Brussels, Belgium: Commission of the European Communities.

EC (European Commission). 2002b. "Towards a Global Partnership for Sustainable Development." In *COM(2002) 82*, edited by Commission of the European Communities. Brussels, Belgium: Commission of the European Communities.

EC (European Commission). 2010. "EUROPE 2020—A Strategy for Smart, Sustainable and Inclusive Growth." In *COM(2010)*, 1–6. Brussels, Belgium.

Engelbrech, G., G. Küppers, and J. Sonntag. 1978. "Regionale Wirkungen von Hochschulen.", Bd. 25, Schriftenreihe "Raumordnung" des Bundesministers für Raumordnung, Bauwesen und Städtebau, Bonn.

Etzkowitz, H., and L. Leydesdorff. 1997. "Introduction: Universities in the Global Knowledge Economy." In *Universities and the Global Knowledge Economy: A Triple Helix of University-Industry-Government Relations*, edited by Henry Etzkowitz and Loet Leydesdorff, 1–8. London, UK: Pinter.

Fabian, G., and Karl-Heinz Minks. 2008. "Muss i denn zum Städtele hinaus? Erwerbsmobilität von Hochschulabsolventen." *HIS: Magazin* 3:4–5.

Falk, Susanne, and Fabian Kratz. 2009. "Regionale Mobilität von Hochschulabsolventen beim Berufseinstieg." *Beiträge zur Hochschulforschung* 3:52–67.

Filho, W. L. 2011. "Applied Sustainable Development: A Way Forward in Promoting Sustainable Development in Higher Education Institutions." In *World Trends in Education for Sustainable Development*, edited by W. L. Filho, 11–30. Frankfurt, Germany: Peter Lang GmbH.

Fischer, Georges, and Markus Nef. 1990. *Die Auswirkungen der Hochschule auf Stadt und Kanton St. Gallen. Ergebnisse einer regionalen Inzidenzanalyse. Vol. Band 23*. Grüsch, Switzerland: Verlag Rüegger.

Fischer, G., and B. Wilhelm. 2001. *Die Universität St. Gallen als Wirtschafts- und Standortfaktor. Ergebnisse einer regionalen Inzidenzanalyse*. St. Gallen, Switzerland: Haupt Verlag.

Florax, R. J. 1992. *The University: A Regional Booster? Economic Impacts of Academic Knowledge Infrastructure*. Aldershot, UK: Avebury.

Florida, R. 2002. *The Rise of the Creative Class: and How it's Transforming Work, Leisure, Community and Everyday Life*. New York: Basic Books.

Franz, P., M. T. Rosenfeld, and D. Roth. 2002. "Was bringt die Wissenschaft für die Wirtschaft in einer Region? Empirische Ergebnisse zu den Nachfrageeffekten und Hypothesen über mögliche Angebotseffekte der Wissenschaftseinrichtungen in der Region Halle." In *IWH Diskussionspapiere*.

Frey, Rene, and Ernst Brugger. 1984. *Infrastruktur, Spillovers und Regionalpolitik. Methode und praktische Anwendung der Inzidenzanalse in der Schweiz, Reihe "Thema-Hefte"*. Diessenhofen, Switzerland: Verlag Rüegger.

Fritsch, Michael, Knut Koschatzky, Ludwig Schätzl, and Rolf Sternberg. 1998. "Regionale Innovationspotenziale und innovative Netzwerke." *Raumforschung und Raumordnung* 4:243–52.

Fritsch, Michael, and Christian Schwirten. 1999. "Enterprise-University Co-operation and the Role of Public Research Institutions in Regional Innovation Systems." *Industry and Innovation* 6:69–83.

Fritsch, Michael, and Viktor Slavtchev. 2005. "The Role of Regional Knowledge Sources for Innovation—An Empirical Assessment." *Freiberger Arbeitspapiere* 15:34.

Fromhold-Eisebith, E. 1992. *Wissenschaft und Forschung als regionalwirtschaftliches Potential? Das Beispiel von Rheinisch-Westfälischer Technisher Hochschule und Region Aachen*. Aachen, Germany: University of Aachen.

Fromhold-Eisebith, E., and H. Nuhn. 1997. *Regionaler Wissenstransfer aus Grossforschungseinrichtungen. Angebotspotential, Nachfragestrukturen und bisherige Effekte in den Raäumen Karlsruhe und Jülich / Aachen*, Erdkunde 51:209–29.

Funtowicz, O., and J. R. Ravetz. 1993. "Science for the Post-normal Age." *Future* 25: 739–55.

Fürst, Dietrich. "Die Wirkung von Hochschulen auf ihre Region." In *Wirkungsanalyse und Erfolgskontrolle in der Raumplanung, Forschungs- und Sitzungsberichte der ARL*, edited by ARL, 135–52. Hannover, 1984.

Fürst, Dietrich, and Hans-Jürgen Back. 2011. "Der Beitrag von Hochschulen zur Entwicklung einer Region als "Wissensregion". In *E-Paper der ARL*. Hannover, Germany: Akademie für Raumforschung und Landesplanung.

Gardner, R. W. 1981. "Macrolevel Influences on the Migration Decision Process." In *Migration Decision Making. Multidisciplinary Approaches to Microlevel Studies in Developed and Developing Countries*, edited by G. DeJong and R. W. Gardner, 13–58. New York: Pergamon Press.

Geipel, Robert. 1970. "Der Beitrag der Sozialgeographie zur Regionalen Bildungsforschung." In *Beiträge zur Regionalen Bildungsplanung*, edited by ARL, 1–16. Hannover, Germany: ARL.

Geißler, C. 1965. "Hochschulstandorte—Hochschulbesuch." In *Schriftenreihe der Arbeitsgruppe Standortforschung*. Hannover, Germany: Vincentz.

Gensch, Frowin. 1980. "Hochschulneugründungen, eine raumwirksame Maßnahme?" *Beiträge zur Hochschulforschung* 3:243–70.

Gerhardter, Gabriele, and Markus Gruber. 2001. *Regionalförderung als Lernprozess. Evaluierung der Förderung des Bundeskanzleramtes für eigenständige Regionalentwicklung*. Vol. Nr. 32, Schriften zur Regionalpolitik und Raumordnung. Wien, Austria: Druckerei Dorner.

Gibbons, Michael, C. Limoges, Helga Nowotny, S. Schwartzmans, Peter Scott, and M. Trow. 1994. *The New Production of Knowledge: The Dyanamics of Science and Research in Contemporary Societies*. London, UK: Sage.

Glatz, Hans, and G. Scheer. 1981. "Neue Entwicklungsstrategien für strukturschwache ländliche Regionen." In *Studie des IHS im Auftrag des Bundeskanzleramtes*. Wien, Austria: Institut für Höhere Studien.

Goddard, J., and P. Vallance. 2011. *The Civic University and the Leadership of Place*. Newcastle, New South Wales: CURDS, Newcastle University.

Goldstein, H. 2010. "The 'Entrepreneurial Turn' and Regional Economic Development Mission of Universities." *Annals of Regional Science* 44:83–109.

Gunasekara, C. 2006a. "Reframing the Role of Universities in the Development of Regional Innovation Systems." *Journal of Technology Transfer* 31:101–13.

Gunasekara, C. 2006b. "Academia and Industry. The Generative and Development Roles of Universities in Regional Innovation Systems." *Science and Public Policy* 33:137–50.

Hirsch Hadorn, G. 2008. *Handbook of Transdisciplinary Research*. Dordrecht, the Netherlands: Springer.

Hoffmann-Nowotny, Hans-Joachim. 1970. *Migration. Ein Beitrag zu einer soziologischen Erklärung*. Stuttgart, Germany: Ferdninand Enke Verlag.

Holtta, S., and P. Malkki. 2000. *UNIREG North Karelia Regional Report*. Tampere, Finland: Department of Administrative Sciences, University of Tampere.

Karlsson, C., and W.-B. Zhang. 2001. "The Role of Universities in Regional Development. Endogeneous Human Capital and Growth in a Two-region Model." *Annals of Regional Science* 35:179–97.

Klein, J. T. 2001. *Transdisciplinarity: Joint Problem Solving among Science, Technology and Society*. Basel, Switzerland: Birkhäuser.

Kunzmann, K., and L. Tata. 2000. *UNIREG Ruhr Regional Report*. Dortmund, Germany: Spatial Planning in Europe, University of Dortmund.

Lassnigg, L., Martin Unger, Hans Pechar, and Ada Pellert. 2003. "Review des Auf- und Ausbaus des Fachhochschulsektors." In *Studie im Auftrag des Bundesministeriums für Bildung, Wissenschaft und Kultur. Endbericht*. Wien, Austria: Institut für Höhere Studien

Leusing, B. 2007. "Hochschulen als Standortfaktor Eine empirische Analyse der regionalökonomischen Effekte der Universität Flensburg." *Discussion Paper* 15:52. Flensburg, Germany: Universitöt Flensburg.

Leydesdorff, Loet, and Martin Meyer. 2003. "The Triple Helix of University-industry-government Relations." *Scientometrics* 58:191–203.

Lozano, R. 2006. "Incorporation and Institutionalization of SD into Universities: Breaking through Barriers to Change." *Journal of Cleaner Production* 14:787–96.

Lucas, W. A. 1974. *The Case Survey Method: Aggregating Case Experience*. Santa Monica, CA: Rand Corporation.

Maier, G., F. Tödtling, and M. Trippl. 2006. *Regional- und Stadtökonomik 2. Regionalentwicklung und Regionalpolitik*. Wien, Austria: Springer.

Mayr, Alois. 1979. *Universität und Stadt. Eine stadt-, wirtschafts- und sozialgeographischer Vergleich alter und neuer Hochschulstandorte in der Bundesrepublik Deutschland*. Edited by Münstersche Geographische Arbeiten, 375. Essen, Germany: Schöningh.

Meusburger, P. Bildungsgeographie. 1998. *Wissen und Ausbildung in der räumlichen Dimension*. Berlin, Germany: Spektrum Akademischer Verlag.

Meusburger, Peter, and A Schmidt. 1996. "Ausbildungsniveau und regionale Mobilität. Zur Abwanderung von Hochqualifizierten aus Vorarlberg." In *Auswanderungen aus Österreich: von der Mitte des 19. Jahrhunderts bis zur Gegenwart*, edited by T. Horvath and G. Neyer, 411–31. Wien, Austria: Böhlau.

Mohr, Henrike. 2002. "Räumliche Mobilität von Hochschulabsolventen." In *Arbeitsmärkte für Hochqualifizierte. Beiträge zur Arbeitsmarkt- und Berufsforschung*., edited by L. Bellmann and J. Velling, vol. 256. 248–79. Nürnberg, Germany: L. Bellmann and J. Velling

Moulaert, Frank, and Farid Sekia. 2002. "Territorial Innovation Models: A Critical Survey." *Regional Studies* 37:289–302.

Newig, J., and O. Fritsch. 2009. *The Case Survey Method and Applications in Political Science*. APSA 2009 Meeting. Toronto. September 3–6.

Nowotny, Helga, Peter Scott, and Michael Gibbons. 2001. *Re-thinking Science. Knowledge and the Public in an Age of Uncertainty*. Cambridge, UK: Polity Press.

Nowotny, Helga, Peter Scott, and Michael Gibbons. 2003. "'Mode 2' Revisited: The New Production of Knowledge." *Minerva* 41:179–94.

OECD (Organization for Economic Cooperation and Development). 2003. *The Source of Economic Growth in OECD Countries*. Paris, France: Organization for Economic Cooperation and Development.

ÖROK (Österreichische Raumordnungskonferenz). 1992. *Österreichisches Raumordnungskonzept ÖREK 1991*. Wien, Austria: Österreichische Raumordnungskonferenz.

ÖROK (Österreichische Raumordnungskonferenz). 2002. *Das Österreichische Raumentwicklungskonzept ÖREK 2001*. Edited by Geschäftsstelle der Österreichische Raumordnungskonferenz. Wien, Austria: Eigenverlag.

ÖROK (Österreichische Raumordnungskonferenz). 2011. *Das Österreichische Raumentwicklungskonzept ÖREK 2011*. Edited by Österreichische Raumordnungskonferenz (ÖROK). Wien, Austria: Eigenverlag.

Oser, U., and E. Schröder. 1995. *Die Universität Konstanz als Wirtschaftsfaktor für die Region*, 1–10. Konstanz, Germany: Center for International Labor Economics (CILE).

O'Shea, Rory, Harveen Chugh, and Thomas Allen. 2008. "Determinants and Consequences of University Spinoffs Activity: A Conceptual Framework." *Journal of Technology Transfer* 33:653–66.

Peisert, H. 1975. *Student in Konstanz. Standort, Einzugsbereich und Motive für das Studium an einer neuen Universität*. Konstanz, Germany: Forschungsbericht 19 des Zentrum I Bildungsforschung/ SFB 23. Universitðt Konstanz.

Peisert, H. 1984. *Regionale Hochschulplanung unter veränderten Verhältnissen*. Hannover, Germany: Vincentz.

Pfähler, W. 1997. *Bildung und Wissenschaft als Wirtschafts- und Standortfaktor. Die regionalwirtschaftliche Bedeutung der Hamburger Hochschulbildungs- und Wissenschaftseinrichtungen*. Baden-Baden, Germany: Nomos-Verlagsgesellschaft.

Pirnay, Fabrice, Bernard Surlemont, and Frédéric Nlemvo. 2003. "Toward a Typology of University Spin-offs." *Small Business Economics* 21:355–69.

Pohl, C., and G. Hirsch Hadorn. 2007. *Principles for Designing Transdisciplinary Research*. Edited by Proposed by the Swiss Academies of Arts and Sciences. München, Germany: Oekom.

Ravenstein, E. G. 1972. "Die Gesetze der Wanderung." In *Regionale Mobilität*, edited by György Szell, 41–87. München: Nymphenburger Verlags-Handlung.

Robbins, Lord. 1963. *Report of the Committee on Higher Education (The Robbins Report)*. Report of the Committee appointed by the Prime Minister under the Chairmanship of Lord Robbins, Great Britain, UK.

Rolfes, Manfred. 1996. *Regionale Mobilität und akademischer Arbeitsmarkt*, edited by Universität Osnabrück. Vol. Band 17, *Osnabrücker Studien zur Geografie*. Osnabrück, Germany: Universitätsverlag rasch.

Rosenfeld, M. T., and D. Roth. 2004. "Wissenschaftseinrichtungen und regionale Wirtschaftsentwicklung—Ergebnisse einer Untersuchung am Beispiel der Wissenschaftseinrichtungen in der Region Halle." *Diskussionspapier des Institutes für Wirtschaftsforschung Halle No* 190:25

Sauerborn, K. 2005. "Die regionalwirtschaftliche Bedeutung von Hochschulen." *Zeitschrift für Angewandte Geographie* 3:148–51.

Schäfer, H., and G. Leithauser. 1992. *Die wirtschaftliche Bedeutung der Universität Bremen für die Region Bremen*. Bremen, Germany: Institut für Konjunktur und Strukturforschung der Universitöt Bremen.

Schmidt, S. J. 1996. *Koginitive Autonomie und soziale Orienteirung*. Frankfurt am Main, Germany: Suhrkamp.

Schramm, W. 1980. "Studentisches Wohnen in der Hochschulstadt." *Schriftenreihe AG Standortforschung der TU Hannover* 6:146.

Sjaastad, Larry A. 1962. "The Costs and Returns of Human Migration." *The Journal of Political Economy* 70:80–93.

Spehl, H., H. D. Feser, and P. Schulze. 2005. "Regionalwirtschaftliche Wirkungen der Hochschulen und Forschungseinrichtungen Rheinland-Pfalz. Wertschöpfungs-, Einkommens- und Beschäftigungseffekte durch den Bau und Betrieb der Einrichtungen." Trier, Germany.

Spehl, H., H. D. Feser, and P. Schulze. 2007. "Regionalwirtschaftliche Wirkungen der Hochschulen und Forschungseinrichtungen in Rheinland-Pfalz. Effekte wissenschaftlicher Einrichtungen auf Humankapital, Gründungen, Wissens- und Technolgietransfer sowie Wachstum und Innovation (Leistungsabgabe)." In Endbericht Phase I. edited by TAURUS Institut an der Universität Trier, Lehrstuhl Volkswirtschaftslehre und Wirtschaftspolitik Technische Universität Kaiserslautern, Institut für Statistik und ökonometrie der Johannes-Gutenberg Universität Mainz. Trier, Germany: TAURUS Institut, Universität Trier.

Strauf, Simone, and Roland Scherer. 2008. "Universities and their Contribution to Regional Development." *Transformations in Business and Economics* 7:137–51.

Thanki, R. 1999. "How Do We Know the Value of Higher Education to Regional Development?" *Regional Studies* 33:84–89.

Tödtling, Franz, Patrick Lehner, and Michaela Trippl. 2007. "Innovation in Knowledge Intensive Industries: The Nature and Geography of Knowledge Links." *European Planning Studies* 14:1035–58.

Uyarra, E. 2010. "Conceptualizing the Regional Roles of Universities, Implications and Contradictions." *European Planning Studies* 18:1227–46.

Van der Meer, E., and B. Groenevelt. 2000. *UNIREG Regional Report: The Region Twente*. Amsterdam, the Netherlands: Study Centre for the Metropolitan Environment, University of Amsterdam.

Velazquez, L. 2006. "Sustainable University: What Can Be the Matter?" *Journal of Cleaner Production* 14:810–19.

Voigt, E. 1995. "Die Universität als regionaler Wirtschaftsfaktor—eine Analyse am Beispiel der TU Ilmenau." *Diskussionspapier Technische Universität Ilmenau* 1:33.

Webler, W.-D. 1983. "Regionale Bindung der Studenten—Berufsqualifikation im Studium—Regionaler Arbeitsmarkt." In *Hochschule und Region. Wechselwirkungen. Bielefelder Beiträge zur Ausbildungsforschung und Studienreform*, edited by W.-D. Webler, 275–98. Basel, Switzerland: Beltz.

Weichhart, Peter. 1993. "Mikroanalytische Ansätze der Sozialgeographie—Leitlinien und Perspektiven der Entwicklung." *Innsbrucker Geographische Studien Bd* 20:101–15.

Willauschus, Axel. 1979. *Wirtschaftliche Verflechtungen zwischen Hochschule und Stadt. Eine empirische Analyse am Beispiel der Stadt Münster und ihren Hochschulen*. Baden-Baden, Germany: Nomos Verlag GesmbH.

Wolf-Wicha, B. 1982. *Das Österreichische Raumordnungskonzept ÖRK*. Edited by Österreichische Raumordnungskonferenz (ÖROK). Wien, Austria: Eigenverlag.

Woll, A. 1966. "Die wirtschaftliche und fiskalische Bedeutung der Universität für die Stadt." *Schriften der Justus-Liebig-Universität* 5:29.

Yin, R. K., and K. A. Heald. 1975. "Using the Case Survey Method to Analyze Policy Studies." *Administrative Science Quarterly* 20:371–81.

Zellweger, T., P. Sieger, and F. Halter. 2011. "Should I Stay or Should I Go? Career Choice Intentions of Students with Family Business Background." *Journal of Business Venturing* 26:521–36.

ZEW (Zentrum für Europäische Wirtschaftsforschung). 2002. *Spinoff-Gründungen aus der öffentlichen Forschung in Deutschland*. eXIST Studien No 4. Bonn, Germany: Bundesministerium für Bildung und Forschung.