

Innovation in developing countries

examining two decades of research

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Innovation in developing countries: examining two decades of research

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ABSTRACT

This article examines how the literature on innovation in developing countries has developed in the social science-related disciplines over the last two decades. While increasing fourfold in the last decade compared to the decade before, the bulk is on middle-income emerging economies. These emerging economies, especially China, increasingly shape the thematic orientation of the literature. In this respect, low-income countries remain marginal, and research on them is rather fragmented. Furthermore, new disciplinary fields that did not exist or were small 20 years ago have been central in the literature's overall advance. Yet, it is mainly informed by theoretical concepts developed in the rich world and outside innovation and development studies. However, we argue that the innovation and development research community is well positioned to inform this increasing interest in innovation in developing countries. To do so, it should strengthen its core with grounded theory building, seek complementarities with other theoretical traditions, and endorse openness and collaboration with development research in domains such as agriculture, energy and health. This may strengthen the ability of the community to better inform policies for societal change.


KEYWORDS

Innovation studies; innovation and development; literature survey; developing countries; low- and middle-income countries; bibliometric analysis

1. Introduction

The idea that innovation is at the heart of economic and social development has become widely accepted. For example, many low- and middle-income countries have recently added innovation policy to their national policy frameworks, and multilateral organizations have brought innovation programmes to the core of policy making (UNESCO 2021). This has been supported by the increasing acknowledgement of ideas about the importance of innovation and innovation capabilities in developing countries, which can be traced back to the early 1970s and 1980s (Crane 1977; Fransman and King 1984; Lall 1987; Singer et al. 1970). However, progress was slow and even after the

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turn of the millennium, mainstream development policy was often buttressed by the view that innovation was first and foremost a phenomenon found in advanced economies and that interventions should be confined to the promotion of *diffusion* to developing countries (see Bell 2009).

This has now changed significantly. The academic literature devoted to the study of innovation in developing countries has expanded rapidly over the last two decades. It has spawned vibrant academic communities associated with innovation studies focused on low- and middle-income countries and their global dimensions. The landscape of journals publishing research in this field is expanding and changing, but so far much of the literature has been published in either established development studies journals or established innovation studies journals. As a ‘new combination’ aimed at bringing these fields together, *Innovation and Development* was created in 2011 to provide a dedicated interdisciplinary outlet for research in this area. In this article, we make use of this journal’s anniversary issue to reflect on how the broader body of research has developed and the implications for the innovation and development research community. We provide a systemic and comprehensive analysis of the literature on innovation in developing countries, focusing on how it has evolved over the last twenty years. We ask this question to look forward and identify the implications for the research agenda and the discussions in and around *Innovation and Development* about how the field can make substantial contributions to addressing major societal challenges in poorer parts of the world.

The article is structured as follows: Section 2 discusses the existing literature and its gaps, specifies the research questions of this article and provides conceptual framing. Section 3 describes the methods and discusses the limitations of the dataset. Section 4 discusses the results of the analysis, highlighting the quantitative changes in the body of literature as well as the qualitative changes related to thematic areas and disciplines. Section 5 then summarizes and discusses our findings. An online appendix attached to this article provides additional empirical details.

2. Innovation in developing countries vs innovation and development

This is not the first article to examine and discuss the literature on innovation in developing countries or its associated research community. However, the existing literature is both sparse and fragmented. In this section, we discuss this extant literature as well as its limitations and gaps, and we clarify key concepts used in our analysis.

Existing reviews have mainly examined the literature to derive insights about specific research questions to provide grounding for empirical studies. Very few studies have sought to address the development of the literature as a field. Conversely, there is also research that discusses the field and its key concepts, which, however, does not draw on systematic literature surveys (Adebowale et al. 2014; Kraemer-Mbula and Wamae 2010). However, there are some important exceptions:

In this article, we are inspired by the seminal paper by Lorentzen (2010), in which he surveyed literature published in the decade 1997–2008. Using the Web of Science (WoS), he identified 152 articles about product, process or organizational innovations in the world’s poorest countries, i.e. low-income countries (LICs). Manual inspection showed that this research tended to focus on households and communities as central units of

analysis rather than on firms and individuals. He concluded that with only a small number of papers published each year, innovation studies had fundamentally neglected the poorer parts of the world. Furthermore, there was no evidence of a systematic research agenda, and he did not find that the literature was produced by a coherent academic community dedicated to research on innovation in these countries. Do these conclusions still hold true a long decade after? Does an analysis focused on poorer countries capture the growing heterogeneity across developing countries? In this respect, what insights emerge if we examine not only the poorest countries but developing country groups at different income levels? These were the original questions that prompted this article.

Pansera and Martinez (2017) provide a more recent review of 218 papers about innovation for development and poverty reduction identified in WoS and Scopus. They selected papers based on keywords to identify research on forms of innovation characterized by conditions of scarcity.¹ This allowed the authors to map the narratives of innovation for development and poverty reduction in the academic literature, showing a growing contribution among business, management, organization and innovation scholars on the topic traditionally prominent amongst development economists. Drawing on the results of citation network analysis, they argue that the evolution of the discourse of development was increasingly intertwined with elements that originated in these business-related disciplines. They limit their analysis to these intertwined fields and do not seek insights from wider social sciences, nor do they distinguish between developing countries at different income levels.

Pugh and Chiarini (2018) provide an interesting comparison between the literature emerging from two research networks on innovation studies research networks, a Global South network (GlobeRICS) and a Global North network (Druid). Examining conference contributions from 2003 to 2017 and 1996–2017 respectively, they find that many thematic trends are overlapping, or rather they are replicated in a way that shows evidence of migration of concepts in both directions. It is precisely such development and amalgamation that we see as promising. Hence the need for more in-depth bibliometric work.

As will be discussed in the next section, we add to this literature with several methodological advances. Importantly, we expand the analysis to seek insights from a wide body of literature that goes well beyond what has been examined in existing studies. In this respect, it is useful to unfold the distinction between the literature on ‘innovation and development’ and the literature on ‘innovation in developing countries’ (Table 1).

The literature on innovation and development is concerned with the role of innovation and technological change in creating and addressing various development problems in the process of structural transformation. Although ‘development’ is typically defined broadly as a multidimensional phenomenon involving transformative structural change with social inclusion and environmental sustainability, it brings together various levels of analysis ranging from the micro (i.e. human or organizational development), over meso (technological or sectoral development) to macro (development of national systems and the global economy). It sees innovation as the main engine that drives and steers the development trajectory. As such, it brings together the two fields of innovation studies and development studies to focus on the intersection. A key distinguishing feature is thus that it draws substantially on concepts and methodologies from innovation studies which are, in turn, defined by its use of common knowledge-based theories and evolutionary approaches (Fagerberg and Verspagen 2009).² Initially, the underpinning theoretical

Table 1. Innovation and development vs innovation in developing countries.

	Innovation and development (Published in this journal)	Innovation in developing countries (Analysed in this paper)
Geographical focus	Global, but with a predominant focus on the 'Global South'	Low-income countries (LICs) and middle-income countries (MICs) as defined by the World Bank
Theoretical and disciplinary foundations	Neo-Schumpeterian innovation studies, Science and Technology Studies (STS) and structuralist development studies. Informed substantially by experiences in the Global South and drawing predominantly on social science disciplines such as economics and sociology	Diverse and/or unspecified. Theoretical foundations are varied and partly reflect embeddedness in not only social sciences, but also a diverse range of other disciplines including engineering, information sciences, operation sciences and education
Definition of development	Transformative structural change with social inclusion and environmental sustainability	Diverse and/or unspecified; phenomena occurring in developing countries

Source: Authors' own, drawing on sources cited in this section. The nature of the literature on innovation in developing countries is further examined and discussed in Section 4.

bases for the literature on 'innovation and development', especially its Schumpeterian heritage, has resulted in a focus on topics related to innovation activities by firms, mostly in manufacturing and high-value services, as a driving force of economic development. Yet, new areas of interest have emerged in this literature over the past decade, related to sectors and dimensions of crucial importance to low-income countries – such as innovation activities performed by disadvantaged and marginalized communities (e.g. informal actors and grassroots innovators), and sectors that are often central to low-income economies (e.g. natural resources, health and agriculture).

The overall literature on 'innovation in developing countries' is much broader. It is premised, at last implicitly, on the recognition that innovation is not exclusive to mature economies alone, but it is also an important issue for developing countries. For operational purposes, we use in this article the dominant term 'developing countries' and define it simply as referring to cover low, lower-middle and upper-middle-income countries as identified by the World Bank. The literature dealing with innovation in these countries is not necessarily (or usually) rooted in development theory but rather geographically situated, and it goes beyond core innovation studies to examine innovation issues in developing countries across a much wider range of domains within or adjacent to the social sciences. As discussed below, these domains include, but are not limited to, management, economics, industrial engineering, environmental studies, information studies and education.

The diversity in disciplines and underpinning theoretical bases has allowed the literature on innovation in developing countries to evolve in various directions. In this article, by looking at the evolution of the broader literature we seek to gather insights into where the overall field is moving towards. In contrast to earlier research mentioned above, we use new data-analytical methods applied to a large corpus of literature. In addition, we seek to contrast research themes deriving from poorer parts of the world with research on emerging economies with higher per capita income levels to obtain a more fine-grained understanding of how the field is developing.

3. Methodology and sources

This section explains the main steps of our bibliometric approach and the rationale behind it. First, we identify the literature on innovation in developing countries by

conducting a systemic search. Second, we describe the evolution of the identified literature on innovation in developing countries at different income levels in terms of growth over time. Third, we describe the disciplinary orientation of the literature on innovation in developing countries and its trends over time, particularly in terms of the WoS subject categories. Finally, we map and analyse the thematic structure of the literature on innovation in developing countries and trends therein by relying on the method from the field of natural language processing (NLP).

Bibliometric studies often use WoS despite several well-known limitations such as the ‘elite’ nature of the data source, which only includes highly established journals.³ In the context of this study there are additional biases inherent in WoS and the global publishing game, which has ramifications that are particularly important in developing countries. Some of these limitations are discussed in this section while others are addressed in the final section as recommendations for new research.

3.1. Identifying the literature on innovation in developing countries

The review is based on a search performed using the Social Science Citation Index (SSCI) in the ISI Web of Science (WoS) database. We searched for all English language scholarly journal articles with the search strings in the title, abstract, and keywords fields. The key search word ‘innovation’ was individually paired with the word phrases for groups of countries (including relevant variation in phrases), as well as with individual countries belonging to income different groups defined by the World Bank. This resulted in seven distinct search strings shown in Table 2 (below). The entire period is divided into two periods of equal duration: 2000–2009 and 2010–2019.

Table 2 below shows the parameters and results of the keyword search used to define our corpus. After removing the duplicates due to issues of inevitable overlap and limiting the articles to scholarly journal articles, the final list of publications resulted in 1348 articles for the period 2000–2009, 9341 for the period 2010–2019, and 10,689 for the whole period.

A limitation of this strategy is that some contributions related to innovation in the context of developing countries where the term ‘innovation’ is less common (e.g. technological change, technological capabilities) might have been overlooked, especially in the 2000–2009 period. However, we believe the term innovation has now become dominant

Table 2. Results of the keywords searches.

Time period		2000–2009	2010–2019	2000–2019
Keywords combinations				
1	Developing countries AND innovation	388	1560	1948
2	Middle income countries AND innovation	12	171	183
3	Low-income countries AND innovation	14	75	89
4	Least developed countries AND innovation	4	22	26
5	LICs: ‘Afghanistan’ ... ‘Yemen’ AND innovation	74	543	617
6	LMICs: ‘Angola’ ... ‘Zimbabwe’ AND innovation	384	2308	2692
7	UMICs: ‘Albania’ ... ‘Venezuela’ AND innovation	893	6777	7670
Sum		1769	11,456	13,225
Duplicates		289	1737	2026
Total articles		1480	9719	11,199
Scholarly journal articles		1348	9341	10,689

Source: Web of Science, Social science citation index (SCCI).

and will feature in the majority of relevant papers. We are thus confident of thematic relevance of the generated set of publications due to our search procedure, which involves a wide geographical focus of our search, that all the search strings contain the term ‘innovation’ and that our search is not limited to the title of publications. However, it is important to acknowledge that due to its size we have not been able to inspect the full corpus manually through reading the full texts; rather manual inspection has been limited to representative articles (see 3.3 Thematic mapping).

3.2. Describing and analysing the evolution: growth across country categories and disciplines

To analyse the magnitude and distribution of the literature between country income groups and over time, the articles in the corpus are further assigned according to World Bank classifications. Each paper is thus assigned one of the following based on analysis of title, abstract and keywords:

- LIC: at least one ‘low-income country’ is mentioned in the paper.
- LMIC: at least one ‘lower-middle income country’ is mentioned
- UMIC: at least one ‘upper-middle income country’ mentioned.
- LIC&MIC: both ‘low and low- and middle-income countries’ mentioned
- LMIC&UMIC both ‘lower and upper middle-income subgroups’ mentioned
- UNASSIGNED: no specific developing countries mentioned, only phrases referring to groups of countries, such as ‘developing countries’.

With respect to the last category, only 1.144 out of the total of 10.689 publications are not assigned to one of the income country groups and are hence entitled ‘not assigned’. Manual inspection of the sample of the not assigned articles shows that some of this research is concerned with comparative analysis of a larger number of countries belonging to more than one income-country group, as well as geographical units of analysis at the lower levels of aggregation than countries, such as cities.

To identify and describe changes over time in the disciplinary orientation of the literature on innovation in developing countries, we draw on the WoS subject categories of publications included in our corpus. Thus, we characterize the literature by the ten largest appearing WoS categories. The appendix provides further information about the top-10 WoS categories including the journals in which the literature is published belongs to 4.2 Shifts in disciplinary orientation.

3.3. Thematic mapping: new language processing

To aid the analysis of our corpus, we use the machine learning technique of natural language processing (specifically, latent Dirichlet allocation (LDA)) to identify research clusters with shared thematic content. LDA topic models are commonly used to identify and describe the latent thematic structure within an extensive collection of text documents. The basic idea is that document collection can be described as a probability distribution over latent topics (inferred from the patterns of words occurrence in the documents). The words occurring in titles, keywords and abstracts of our corpus of

publications are analysed, and each identified topic is a probability distribution of the words used in the whole corpus (Blei 2012). The method generates a list of topics that describe the corpus of publications, maps the publications to identified topics, and evaluates the strength of each topic appearance in each specific publication. The words with the highest assigned probability to each topic define terms that enable description and interpretation of the topic content and meaning.

We label each topic by considering their most associated terms and by qualitatively inspecting the ten articles with the highest assigned probability for each topic. We then interpret the identified topics rather broadly as reflecting the publications' theoretical perspective or framework, context or applied methods. This step inevitably involves a degree of subject judgement, both in term of the overall heading and the keywords provided, based on the identification of terms from the LDA method and from inspecting the topic most representative articles ordered by the total number of citations.

Yet, this method, compared to citation network analysis techniques combined with the clustering techniques, has the advantage of detecting research on the same issue, which is developed in separate intellectual tribes that do not refer to the same literature or each other and therefore do not show up as important themes when other methods are used. This is particularly problematic when, as in this case, the corpus spans several disciplines.

4. The evolution of the literature on innovation in developing countries

This section presents the main findings of the analysis, comprising both quantitative changes in the body of literature related to innovation in developing countries over the past two decades, as well as qualitative changes in disciplinary orientations and key themes.

4.1. Shifts in magnitude and distribution between country income groups

Figure 1 (below) shows the number of journal articles on innovation in developing countries published per year in the social science citation index from 2000 to 2019. We observed that the literature on innovation in low- and middle-income countries has grown on average by 21% each year since the year 2000. Indeed, this is an extraordinary growth rate. However, it is important to recognize that while the literature on innovation in developing countries has grown fast in absolute terms, it is by far outstripped by the growth of research on innovation more generally.⁴

Nevertheless, during the last two decades, the literature on innovation in developing countries saw a shift in gear in terms of annual output around 2007. The growth has been relatively modest over the first period, compared to the second period where the number of yearly articles increased fourfold from 443 (2010) to 1892 (2019). In fact, around 87% of all publications over the last two decades were published in the period 2010–2019.

It is also evident from Figure 1 that the literature is heavily biased towards developing countries that have higher income levels. Most of the literature is on upper-middle income countries, with 6501 papers published over the period. This is followed by 1767 papers on lower-middle income countries and 390 on low-income countries. In other words, there is now a critical mass of literature on innovation in higher-middle income countries and, to some extent, on lower-middle income countries. The literature on low-income countries

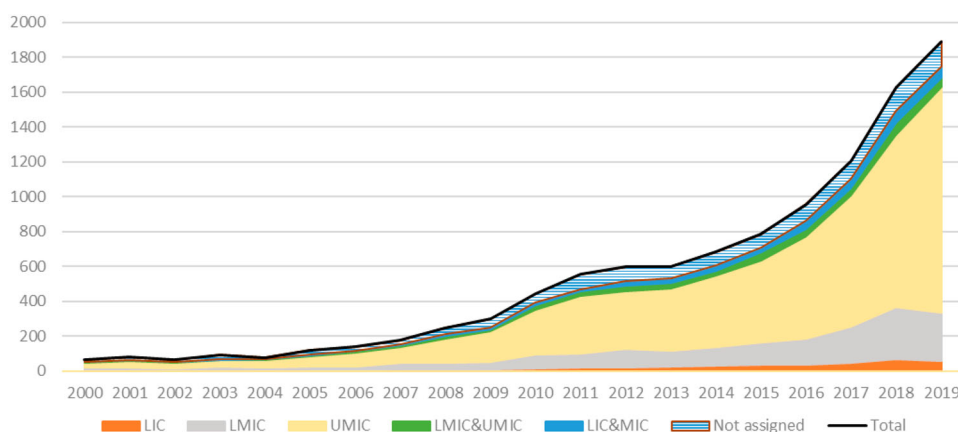


Figure 1. #Evolution of the literature on innovation in developing countries.

Source: Analysis based on Table A1 in the Appendix.

is still embryonic. At a time when thousands of innovation papers are published each year, only 57 LIC papers and 277 LMIC papers were published in Web of Science journals in 2019. Moreover, the literature on LICs and LMICs is focused predominantly on just a small number of countries, such as Ethiopia, Kenya and Nigeria.

As will be discussed later, this has implications for the thematic nature of the literature. In section 4.3 we focus on (a) low and lower and middle-income countries and (b) upper middle-income countries separately to identify the main themes in the two groups. However, in the next sub-section, we include all developing countries to see the disciplines that define the corpus and how they have changed over time.

4.2. Shifts in disciplinary orientations

Figure 2 (below) shows that the literature is spread across a broad array of disciplines and specialities. Each bar represents the top WoS categories appearing in both sub-periods. The vertical axis measures the share of each WoS category in the total number of appearing WoS categories of publications in our corpus for the period 2000–2009 and 2010–2020, respectively.

In both periods, the three subject areas of ‘Management’, ‘Economics’ and ‘Business’ account for the largest shares, followed by ‘Environmental Studies’. Although remaining at the top, the shares of ‘Management’ and ‘Economics’ declined over time, whereas ‘Business’ and especially ‘Environmental Studies’, increased their weight. Environment and sustainability-related fields such as ‘Environmental sciences’, and ‘Green and sustainable science and technology’ have emerged as the dominant group. Considering that the shares of ‘Environmental sciences’ and ‘Green and sustainable science and technology’ were only 1.8% and 0.2% (respectively) in 2000–2009, their rise to the top 10 most prominent areas in 2010–2019 is rather significant, representing how a substantial share of the literature is driven by fields that were very small or did not exist 20 years ago.

As for the rest, Figure 2 shows changes over time in terms of the composition and weights of the identified subject areas. In the earlier period 2000–2009, other areas of social sciences with the greatest share are ‘Development Studies’, and ‘Operations research

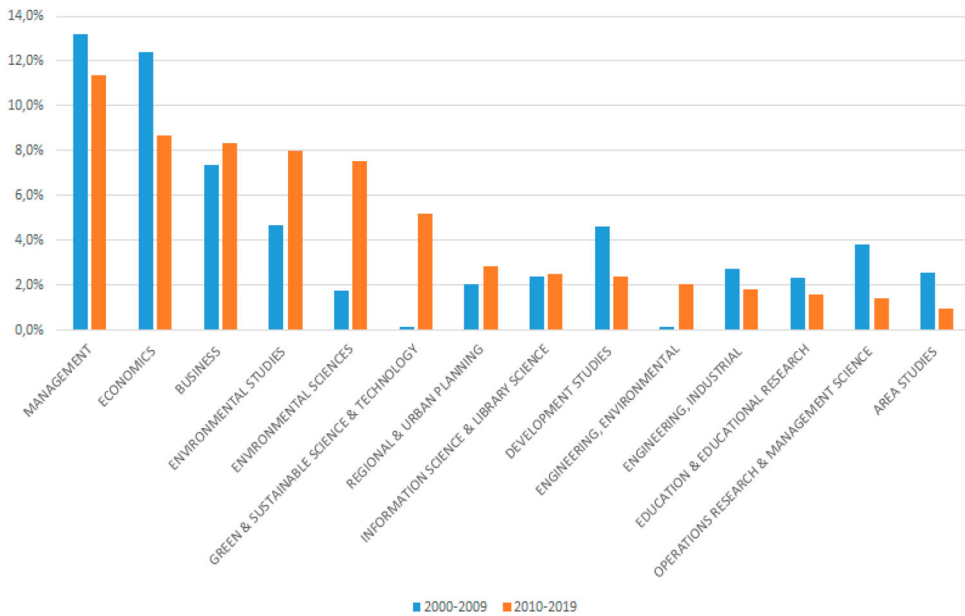


Figure 2. Disciplinary orientation of the literature on innovation in developing countries (top WoS categories), 2000–2019.

Note: For further details, see Table A1 and A2 in Appendix.

and management sciences’, as well as ‘Industrial engineering’. ‘Development Studies’, with a relatively prominent presence in the initial period (4.6%), decreases its share in the subsequent period (2.4%). This finding deserves further consideration since development studies are central in the sub-literature of ‘innovation and development’ as discussed in Section 2 above.⁵ A reduction in the field of ‘development studies’ in recent years may be a reflection of the gradual narrowing down of the academic interest towards exploring innovation in connection with a set of discrete issues related to economic (rather than broader) development, such as competitiveness, productivity growth, catching-up and firm performance, which have a very different normative orientation and are more commonly explored in studies located in the Management, Business and Economics disciplines.

Innovation studies do not have their own category in WoS. As mentioned, the innovation studies field of research is a diverse and interdisciplinary area of social science with somewhat fuzzy boundaries. As mentioned, it is a subset of the overall body of research on innovation across the social sciences. Some of the disciplines (economics, business and management) and journals typically associated with innovation studies still feature prominently. Nevertheless, their relative weight in the literature has declined as other disciplines have grown. The appendix provides further details on the journals in which the literature is published.

4.3. Shifts in key themes across income groups

This section continues our discussion of how the research on innovation in developing countries has evolved, focusing on the thematic orientation of the evolving literature.

This analysis distinguishes between the literature on innovation in the higher income segment among developing countries (UMIC) and the lower-income segment (LIC and LMIC) to explore patterns in the evolution as well as commonalities and differences. Within each group, we identify eight topical clusters with internal thematic coherence (semantic similarity). Tables 3 and 4 (below) provide an overview of the identified topics and indicative keywords for each country group. Obviously, this discussion addresses the very broad strokes only and is merely based on inspection of the top cited sources. Nevertheless, it enables us to look across vast terrain with a view to questions about the basic orientation (e.g. orientation towards societal challenges or not) driving the development of the literature. We start by identifying commonalities in the thematic orientation of the two groups. We identify some key differences and close the section with some short deliberation regarding overall trends.

We start with key overlaps in thematic orientation. We see four common thematic interests across income-group country groups, although importantly they follow different dynamics.

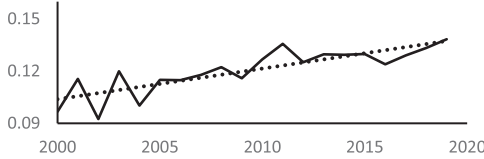
First, there is clear visible fingerprint of the management and business disciplines. A key theme of overlapping interest is the literature on *Leadership and knowledge management*. This body of knowledge displays a clearly growing trend in both income groups over the entire period. It is clearly dominated by studies on China in the higher-income developing country sub-group and India in the lower-income sub-group. It is concerned with management practices, organizational innovation and change in developing country firms. It thus has a clear unit of analysis and includes studies exploring knowledge management practices that can improve creativity in teams and employees (Fong et al. 2018; Yang, Liu, and Gu 2017), and work on transformational leadership in diverse contexts (Malik, Dhar, and Handa 2016; Masood and Afsar 2017; Mittal and Dhar 2015; Tipu, Ryan, and Fantazy 2012; Tung 2016). In general, research in this theme connects to a rather well-defined research agenda and applies quantitative research methods in the context of management, business, and organizational studies. The consistent growth in this thematic area indicates that developing countries are concerned with the improvement of the competitive performance of their businesses. However, being driven by research on China and India, analyses of low-income country firms do not appear in the top-cited sources and there is little attention paid to development beyond the micro level (the firm).

Second, the increasing importance of environmental studies and related disciplines is also clearly visible in both groups with several groups concerned with different aspects of green transformations. In the higher income set of countries, this is the fastest growing theme as it relates to research both on *Green Industrialization*, and *Climate change and Emissions*, which have experienced a steep rise over the past 20 years. Here it is worth noting again a very heavy bias towards China, which is clearly visible in top-cited articles in this list, and which translates into questions around reducing the resource intensity of latecomer industrial development. One of the main preoccupations in this literature is to explore the effect of environmental regulations in the process of green industrialization often relying on quantitative methods (Jin et al. 2019; Li and Wu 2017; Shen et al. 2019; Zhang et al. 2017). Another strand relates to energy efficiency and carbon emissions, with particular focus on policy implications (Hu, Yuan, and Hu 2011; Jiang et al. 2013; Liu, Lin, and Zhang 2016; Peng, Xu, and Fan 2018). It reflects China's aspirations to radically

Table 3. Thematic areas – Upper middle income countries (Subset of 7.110 papers).**Leadership and knowledge management**

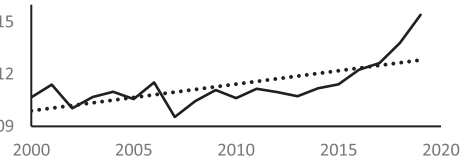
Keywords: leadership, organizational performance, knowledge sharing, innovative behavior.

Top cited references: Fong et al. (2018); Yang et al. (2017); Wang et al. (2017); Tung, F. C. (2016); He et al. (2014).

**Green industrialization**

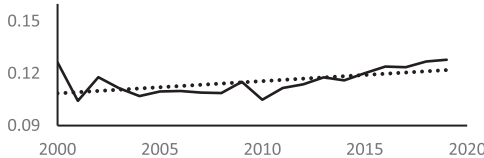
Keywords: eco-innovation, industrial innovation, resource efficiency.

Top cited references: Li, B., & Wu, S. (2017); Yuan, B., Ren, S., & Chen, X. (2017); Zhang et al. (2017); Shen et al. (2019); Jin et al. (2019).

**Climate change and emissions**

Keywords: energy efficiency, energy systems, transport, pollution.

Top cited references: Hu et al. (2011); Jiang et al. (2013); Liu et al. (2016); Peng et al. (2018); Bibas et al. (2015).

**Digital technologies**

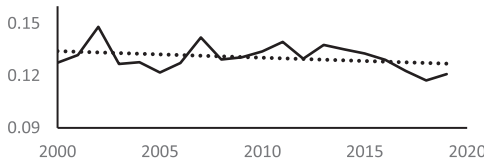
Keywords: technology adoption, mobile services, e-government.

Top cited references: Yang et al. (2012); Alomari et al. (2012); Qi et al. (2009). Koksai, M. H. (2016). Deng et al. (2010).

**Global supply chains**

Keywords: supply chains, MNCs, emerging markets, product innovation.

Top cited references: Jean et al. (2014); Li et al. (2010); Wong et al. (2013); Kothari, T., Kotabe, M., & Murphy, P. (2013); Kotabe, M., & Kothari, T. (2016).

**R&D networks**

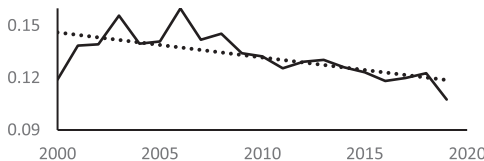
Keywords: university-industry links, spin-offs, technology linkages.

Top cited references: Steffensen et al. (2000); Guan, J., & He, Y. (2007); Hu, X., & Rousseau, R. (2009); Zheng et al. (2013). Li et al. (2008).

**Health and education**

Keywords: service delivery, education, health systems.

Top cited references: Kırkgöz, Y. (2008); Gros et al. (2011); Van Schalkwyk et al. (2014); Kawonga, M., & Fonn, S. (2008); Chariyalertsak et al. (2011).

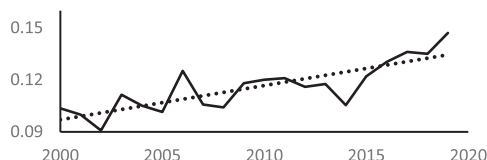
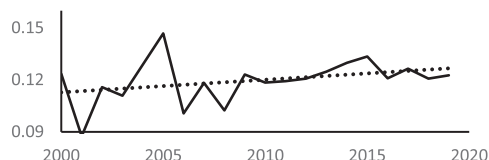
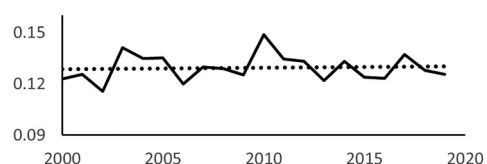
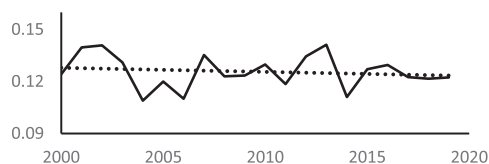
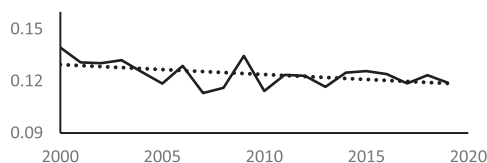
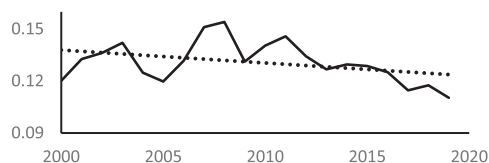
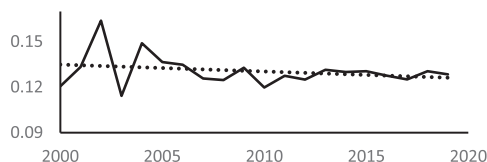
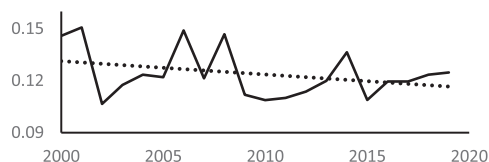
**Socio-political transitions**

Keywords: policy experimentation, development pathways, policy reform, participatory policy.

Top cited references: Heilmann, S. (2008); Jepsen et al. (2015); Wampler, B., & Avritzer, L. (2004). Butler et al. (2014); Eaton, K. (2008).



Note: The figures show topics' weight trends during the observation period and the topics are displayed in order of trendlines (decreasing). The labels are the authors' own, and keywords are based on the LDA analysis and adjusted for readability based on a manual inspection of the top-cited articles in each topic group. References not cited in the main article are provided in the appendix (online).

Table 4. Thematic areas – Low and lower middle income countries (Subset of 3.044 paper).**Leadership and knowledge management***Keywords:* leadership, innovative work behavior, knowledge sharing*Top cited references:* Mittal, S., & Rajib L. D. (2015); Masood, M. & Bilal A. (2017); Malik et al. (2016); Tipu et al. (2012); Taghizadeh et al. (2018).**Health systems***Keywords:* new technologies, service delivery, communities*Top cited references:* Robertson et al. (2015); Ferguson et al. (2012); Zulu et al. (2015); Huq et al. (2014); MacGregor et al. (2011).**Sustainable development and policy***Keywords:* policy planning, scaling-up, capacity, education, environment*Top cited references:* Bates, et al. (2011); Seijger et al. (2017); Chhokar, K. B. (2010); Aikins et al. (2012); Spicer et al. (2014).**Catching up in emerging markets***Keywords:* domestic firms, technology importation, emerging markets, catch-up, international business*Top cited references:* Kumaraswamy et al. (2012); Story et al. (2015); Sasidharan, S. & Vinish K. (2011); Thukral et al. (2008); Lamin, A. & Grigorios L. (2013).**Macro-development and trends***Keywords:* growth, modelling, scenarios, diffusion, international trade, long-run history*Top cited references:* Foreman et al. (2018); de Filippo et al. (2011); Kemp et al. (2010); Potts, R., & J. Tyler Faith (2015); Salisu, A. A., & Hakeem M. (2013).**Low carbon development***Keywords:* technology transfer, local technological capabilities, technology diffusion*Top cited references:* Lewis, J. I. (2007); Ockwell et al. (2008); Power et al. (2016); Lema, A. & Lema R. (2013); Suzuki, M. (2015).**Social innovation***Keywords:* social networks, social innovation, social institutions, transformation*Top cited references:* Scheffran et al. (2012); Birkenholtz, T. (2009); Prasad, S. C. (2016); Rodima-Taylor, D. (2012); Armitage et al. (2011).**Agriculture and rural livelihoods***Keywords:* farm systems, rural livelihoods, households, technology adoption, gender*Top cited references:* Titttonell, et al. (2010); Manda et al. (2016); Theriault et al., (2017); Fisher, M. & Vongai K, (2014); Franke et al. (2019).

Note: See figure 3 for explanations. Note that while some headings are the same as those in Table 3, there may be variations in the specific content (keywords) of the topic.

shift its production model to reduce carbon emissions and make significant breakthroughs in sustainability technologies, which has triggered a massive expansion of its scientific capabilities in environmental and energy research over the period of review. China is currently the largest contributor to new energy research, accounting for more than a quarter of the global publications from 2015 to 2019 (CASISD 2021). In the lower-income country sub-group, this thematic area is manifested in the *Low Carbon Development* theme. While India is present in this theme, it also includes a large array of lower-middle income countries including in sub-Saharan Africa and it is cognisant of local contextual issue as well as the interface between energy development and poverty reduction. It experienced considerable growth over the first half of the period of analysis (2000–2009), but it has been on a decreasing trend over the second period (from 2010 to 2019). This could be due to a shift in the topics and indeed some of the key concepts that drove the earlier growth in this literature, such as technology transfer and the acquisition of green technologies (Lema and Lema 2013; Ockwell et al. 2008). Arguably, there has been shift in attention away from technologies and to organizational models and to unpacking the complex dynamics of technology diffusion in sustainable development, including power imbalances and the broader systemic and institutional capabilities to make strategic choices. This is also manifest in the literature under the theme *Sustainability and capacity-building* in the lower-income countries, which pays attention to policy planning and capacity-building in a sustainable development context. These themes are devoted to innovation to public-good issues and addressing major societal (environmental) challenges.

Health is another of the common themes between the two sub-sets of literature. It is visible in journals that are included in the social science citation index since they have a social science dimension, e.g. as services management or education. In the higher-income group, this thematic covers a broad geography in terms of countries but has been on a gradually decreasing trend over the past 20 years. Some of the preoccupations of this literature related to the combination of technological innovations with innovations in human resource strategies (through education and training) to improve health service delivery (Gros et al. 2011; Kawonga and Fonn 2008; Schalkwyk et al. 2014), as well as the importance of culturally adapted health-related technologies (Chariyalertsak et al. 2011). Conversely, in the lower-income level group, it has been a growing theme, with a clearer focus on ‘systems’, not least on strengthening the governance of health systems through community engagement (Robertson et al. 2015; Zulu et al. 2015) and improving health service delivery for the most disadvantaged and rural communities (Ferguson et al. 2012; Huq et al. 2014). This theme is clearly driven by societal challenges, in particular in the larger group where access and inclusion are driving agendas.

The final common theme has to do with firms, globalization and catching up. Driven mainly by economics but also by management and operations research, it is concerned with multinationals, the nature of competition in global markets, and the opportunities for developing countries. In the higher-income group, where again China is driving, there is interest in product innovation and the modalities of participation of domestic firms in *Global supply chains* and the opportunities for innovation (Jean, Sinkovics, and Hiebaum 2014; Wong, Wong, and Boon-Itt 2013). This literature was closely tied to the Asian workshop of the world of 1990s and 2000s (***), but has experienced a decline over time, as regional markets gained relevance, and the earlier perceived urgency to

better understand the position that developing country firms occupy in the global production landscape was well understood. In lower-income countries, the theme *Catching up in emerging markets* has a high presence of studies on India and is concerned with market liberalization dynamics and their effect on emerging markets. More specifically, this body of work explores a variety of innovation strategies of domestic firms in trying to upgrade their capabilities or ‘catch up’ (Kumaraswamy et al. 2012; Sasidharan and Kathuria 2011). This theme connects to the discussion about latecomer development often discussed in evolutionary economics but has the focus mainly on firms without very visible attention to institutions, science, technology and innovation (STI) systems and policies. Moreover, it is again driven by the large emerging economies with poorer countries in Africa, Asia and Latin America being invisible in the top-cited literature.

After exploring the four common themes, we turn to discuss some of the themes that are specific to each of the income-level groups. In higher income developing countries, there has been a steady increase over time of the theme related to *Technology adoption and digitalization*, aiming to understand the effects of the use of digital technologies, the learning mechanisms attached to digitalization and ways to leverage the new digitally enabled services. One specific dimension that has received attention in this literature relates to the factors affecting the acceptance and perceptions of users of digital technologies in developing countries (Koksal 2016; Qi et al. 2009; Yang et al. 2012). On the contrary, studies exploring *R&D networks* have significantly decreased in the review period. Within this theme, some of the early studies looked at research commercialization through technology patents and spinoffs coming out of university research (Guan and He 2007; Steffensen, Rogers, and Speakman 2000), while there is a more recent interest in exploring international research collaborations, especially in emerging technologies (Zheng et al. 2014). Here are clear connections to innovation and development research looking at innovation systems, university-industry linkages, etc. but there are very few theoretical overlaps. Another interesting theme with links to discussions about people-centred innovation processes is *Socio-political transitions* which has seen a declining trend, however. It is concerned with policy experimentation and participatory publics and issues highly relevant to key issues such as inclusion, but again links very weakly with theoretical frameworks in innovation studies.

In the lower-income countries, large parts of the literature still focus on agriculture as one of the most important issues in poor countries, as also identified in Lorentzen (2010, 53). The cluster which we have entitled *Agriculture and rural livelihoods* is concerned with the agricultural innovations, their diffusion and adoption by rural households or farmers, their impact on farms’ productivity, households’ cost and income, and ultimately the development goals such as food security, poverty reduction and environmental sustainability (Theriault, Smale, and Haider 2017; Tittonell et al. 2010). A second theme that has gained visibility over the years in this group is *Social innovation*, which is a growing body of research focused on innovation to tackle social and societal challenges affecting the most vulnerable communities and shows some early linkages with the literature on socio-technical (sustainability) transitions (Prasad 2016). It also deals with innovation in urban governance, community development and social networks (Rodima-Taylor 2012; Scheffran, Marmer, and Sow 2012). These themes are explicitly focused on societal challenges and issues around adoption of innovative technologies and practices.

In sum, there are both overlaps and unique characteristics in the two sub-sets of literature. There are varying degrees of attention paid to ‘development’ and most of the thematic clusters are only weakly connected to innovation studies. Overall the evolution of the thematic orientation in the higher-income and lower-income groups, has been driven substantially by issues important in China and India respectively.⁶

Research on energy and research on intra-firm management issues showed stark increases in their representation in the corpus, whereas some of the themes more typical of core innovation studies (technologic development and firms, industries and innovation) declined. It needs to be recalled, however, that these trends are driven by the larger segment of corpus, which relates to upper-middle-income countries. Zooming into the literature on low-income countries, the picture is different. Here, the research themes of the agricultural sector (primary livelihoods), health, and sustainability governance are still more important.

Finally, it is worth noting that the lower-income sub-group is characterized by more fluctuating trends. Part of this could be because there is still a rather fragmented knowledge base concerned with innovation in the lower-income sub-group combined with a scientific community that is driven substantially by external sources of funding, which results in more ‘erratic’ trends over time.

5. Conclusions

In this article, we set out to examine how the literature on innovation in developing countries has developed over the last two decades, what the emerging trends are and what the implications are for the research community focused on innovation and development. The study was driven by the following substantive questions: *How has research on innovation in developing countries evolved over the last twenty years? How does the embryonic stage twenty years ago compare with the situation today? What are the key disciplines that contribute to this literature? What are the emerging themes? How does the literature on upper middle-income countries compare to that on low- and lower middle-income countries?* Our analysis provides some new insights in response to these questions. In this concluding section we summarize the main findings, provide recommendations for the innovation and development research community and make suggestions for further research.

5.1. Summary of the main findings

Our conclusions are fivefold. First, the situation has changed significantly from when only a handful of papers on innovation in developing countries were published each year. The overall literature has quadrupled in the last decade compared to the decade before. Whereas there was once a perception that innovation was only a phenomenon of the most advanced economies, this is clearly no longer the case.

Second, although the literature on innovation in developing countries has grown substantially, it is still primarily focused on upper-middle-income countries, especially China. Poorer countries remain marginal in relative terms. Research on innovation is thus not distributed in proportion to population lines, but mainly along income level lines. India dominates research on lower-middle income countries and many low-income countries are entirely absent.

Third, the growth of the literature is driven substantially by the disciplinary fields of management, economics and business. However, a range of environment-related fields, some of which were absent or barely visible 20 years ago, have made significant inroads. Development studies, planning and geography are rather marginal.

Fourth, the literature addresses a very broad range of issues and has a complex pattern of thematic groups. But the structural features already mentioned have important bearings on the thematic nature of the literature. In our analysis of themes and their trends, we pointed out that China and India dominate the overall research agenda, in particular with management and economics-focused issues, as well as with several environment and climate related themes. A diverse range of research themes driven more by other countries and disciplines feature much less prominently.

Fifth, there are both commonalities and distinctive features in the two sub-sets of literature, on upper middle-income countries and low- and lower middle-income countries respectively. The disciplinary underpinnings mentioned earlier and the orientation towards societal challenges and the overall attention paid to issues related to 'development' is uneven in both sub-sets of literature. In the literature on low-income countries, themes such as agricultural and rural livelihoods, and social innovation at the margins are still more important.

Despite a broad range of topical themes, the overall body of literature appears rather fragmented with very different disciplinary underpinnings that pull in different directions. In this sense, the innovation and development research community is well positioned to inform this increasing interest in innovation in developing countries. This is what we discuss next.

5.2. Reflections for developing the innovation and development research community

As innovation and development researchers, we see several important implications from this analysis. The perspective of innovation and development – which follows an evolutionary and critical approach – is still only weakly reflected in the rapidly growing literature on innovation in developing countries. In fact, the literature is highly disjointed, and many of the thematic groups mentioned above are only dealing tangentially with the innovation process itself. This is one key area where the community associated with this journal has a core strength and can (and should) reach out and form new collaborative relations with domain experts working on key themes as identified in this article. There is thus a need for active efforts to engage with other research communities working on innovation in developing countries outside the core of innovation studies, such as those primarily focused on health, agricultural innovation, energy poverty, etc. There are potentially fruitful avenues for cross-fertilization of streams across the innovation and development community and the wider management, engineering and development studies communities identified in the corpus.

However, connections with adjacent fields need to come in conjunction with a strengthening of the theoretical basis of innovation and development. Parts of the theoretical heritage builds on concepts developed in advanced economies, which are then 'applied' in developing countries. More active efforts are needed in grounded theory building. As highlighted by the analysis in this paper, there is a critical need for

conceptual work and analytical clarity on commonalities and internal differences between innovation patterns in countries at different income levels.⁷

5.3. Further research

Strengthening the roots of our community more equally across countries at different income levels and increasing collaboration and capacity-building is undoubtedly central to the endeavour of bottom-up theory building described above. In fact, we need also to step back and obtain a better understanding of research inequalities in our field – from a standpoint that lends emphasis to both the inherent and functional importance of equity and see innovation research as a global public good. From the perspective of bibliometric analysis, there is therefore a need to expand from ‘research on innovation in developing countries’ (as this paper has done) to ‘innovation research in developing countries’: is the global share of innovation publications by authors residing in developing country institutions increasing or decreasing? Are they becoming more central or more marginal in global co-authorship collaboration networks? Fortunately, there are many researchers in the innovation and development community with the qualifications to take up this research challenge. When it comes to low-income countries, we are conscious that in this paper we largely by-pass enormously important issues related to global funding structures, institutional capacities and biases among those with power in the business of (innovation) research. There is a need for new research on our own community and its truly (or not) global manifestation.

The methodology of this paper, drawing on the Web of Science, has been effective in following up the analysis by Lorentzen (2010), in examining the broad developments in the literature and in identifying key themes. However, new research needs to look ‘below the radar’ and examine a better coverage of global south journals and grey literature for topical analysis. Such methods may also support overall efforts to create a better understanding of the innovation process in the global south and define a research agenda focused on innovation for societal change. Given the innate interest of the research community in innovation and development in activating change through public policy, we believe that the expansion of the research agenda as suggested above, would strengthen the community’s ability to inform policies for societal change.

Notes

1. The following keywords were used for the search: ‘frugal innovation’, ‘bottom of the pyramid’, ‘bottom of the pyramid innovation’, ‘inclusive innovation’, ‘jugaad’, ‘Gandhian innovation’, ‘pro-poor innovation’, ‘below the radar innovation’, ‘resource constrained innovation’, ‘inclusive growth’, ‘inclusive development’, ‘grassroots innovation’. See also the earlier article by Pansera (2013) which deals with the issue of how such concepts challenge mainstream innovation theory.
2. Although there is no succinct and generally accepted definition of ‘innovation studies’, a consensus is that it is a branch of social science research, with its own theories and methods, with a strong focus on the innovation phenomena, including both its process and its outcomes. It is widely known that innovation research in general has grown at an extremely fast pace over the last twenty years (Edler and Fagerberg 2017). As shown by Fagerberg (2013), the number of publications with innovation in the title – as a share of all social science articles (ISI Web of Science) – has grown steadily from the early years

from around 1960 onwards, with a sharp increase after the turn of the century. Since the mid-1980s, the general innovation studies field of research has grown larger in size, become more coherent in terms of the common adoption of specific concepts and theories, and it has become more diverse thematically (Martin 2012).

3. Although the SSCI citation database is a valuable and commonly used database for bibliometric analysis, it has two major limitations. First, the type of literature indexed in the database is mainly scholarly journals (a bias towards 'scholarly'). Second, the representation of the covered journals is largely dependent on the language and the origin of the publications, a bias towards English and US-based journals, and the age of the journal, a bias towards older journals (Landström, Harirchi, and Åström 2012; Martin 2012). Thus, citation databases such as WoS have limitations when analysing research on innovation in developing countries, as it is a field of research that does not sit comfortably with the previously defined boundaries.
4. The attention to aspects of innovation in low- and middle-income countries was much less visible over the decades that followed the take-off phase of innovation studies focused on OECD countries (in the late 1980s and early 1990s), with evidence of growing contributions only from the 2010s onwards and dramatic growth over the last decade (see the appendix).
5. Early contributions at the intersection of innovation and development studies paid attention to issues such as appropriate technology (Crane 1977), seeking to understand how technological development could enhance human fulfilment through the satisfaction of human needs. Over time, scholars from development studies increasingly embraced the idea that the capacity for social and economic development crucially involves supporting innovation.
6. While China-related innovation research has virtually exploded over the last decade, it is a trend that has a longer history, as was also noted by Lorentzen (2010). In the decade after the turn of the century, significant attention was paid to innovation and technological development in the BRIC countries (Tseng 2009) while low-income countries are largely ignored.
7. The neo-Schumpeterian focus on formal sectors and firms in manufacturing and high-value services has clear constraints in this respect and new theory building is needed. This can draw on important research which has already been produced in areas such as inclusive innovation (Chataway, Hanlin, and Kaplinsky 2014; Heeks, Foster, and Nugroho 2014) in the informal sector (Cozzens and Sutz 2014; Kraemer-Mbula et al. 2019; Kraemer-Mbula and Wunsch-Vincent 2016) and sectors more relevant to many poorer developing countries, such as natural resources (Pérez, Marín, and Navas-alemán 2014).

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References

- Adebowale, Boladale Abiola, Bitrina Diyamett, Rasmus Lema, and Oyebanji Oyelaran-Oyeyinka. 2014. "Introduction." *African Journal of Science, Technology, Innovation and Development* 6 (5): v–xi. doi:10.1080/20421338.2015.1010774.
- Bell, Martin. 2009. Innovation capabilities and directions of development. In *STEPS Working Papers* (Vol. 33). STEPS Centre.
- Blei, David M. 2012. "Probabilistic Topic Models." *Communications of the ACM* 55 (4): 77–84. doi:10.1145/2133806.2133826.
- CASISD. 2021. *New Energy Technology Research Opportunities and Challenges*. <http://english.casisd.cn/research/rp/202104/P020210414280971702407.pdf>.
- Chariyalertsak, Suwat, Tanyaporn Wansom, Surinda Kawichai, Cholphicha Ruangyuttikarna, Verne F. Kemerer, and Albert W. Wu. 2011. "Reliability and Validity of Thai Versions of the MOS-HIV and SF-12 Quality of Life Questionnaires in People Living with HIV/AIDS." *Health and Quality of Life Outcomes* 9 (1): 15. doi:10.1186/1477-7525-9-15.
- Chataway, Joanna, Rebecca Hanlin, and Raphael Kaplinsky. 2014. "Inclusive Innovation: An Architecture for Policy Development." *Innovation and Development* 4 (1): 33–54. doi:10.1080/2157930X.2013.876800.
- Cozzens, Susan, and Judith Sutz. 2014. "Innovation in Informal Settings: Reflections and Proposals for a Research Agenda." *Innovation and Development* 4 (1): 5–31. doi:10.1080/2157930X.2013.876803.
- Crane, Diana. 1977. "Technological Innovation in Developing Countries: A Review of the Literature." *Research Policy* 6 (4): 374–395. doi:10.1016/0048-7333(77)90013-0.
- Edler, Jakob, and Jan Fagerberg. 2017. *Innovation Policy: What, Why, and How*. doi:10.1093/oxrep/grx001.
- Fagerberg, Jan. 2013. "Innovation – A New Guide." In *Working Papers on Innovation Studies* (No. 20131119).
- Fagerberg, Jan, and Bart Verspagen. 2009. "Innovation Studies—The Emerging Structure of a New Scientific Field." *Research Policy* 38 (2): 218–233. doi:10.1016/j.respol.2008.12.006.
- Ferguson, Laura, James Lewis, Alison D. Grant, Deborah Watson-Jones, Sophie Vusha, John O. Ong'ech, and David A. Ross. 2012. "Patient Attrition between Diagnosis with HIV in Pregnancy-Related Services and Long-Term HIV Care and Treatment Services in Kenya." *JAIDS Journal of Acquired Immune Deficiency Syndromes* 60 (3): e90–e97. doi:10.1097/QAI.0b013e318253258a.
- Fong, Patrick S. W., Chenchao Men, Jinlian Luo, and Ruiqian Jia. 2018. "Knowledge Hiding and Team Creativity: The Contingent Role of Task Interdependence." *Management Decision* 56 (2): 329–343. doi:10.1108/MD-11-2016-0778.
- Fransman, Martin, and Kenneth King, eds. 1984. *Technological Capability in the Third World*. Palgrave Macmillan UK. doi:10.1007/978-1-349-17487-4.
- Gros, Daniel F., Martha Strachan, Kenneth J. Ruggiero, Rebecca G. Knapp, B. Christopher Frueh, Leonard E. Egede, C. W. Lejuez, Peter W. Tuerk, and Ron Acierno. 2011. "Innovative Service Delivery for Secondary Prevention of PTSD in at-Risk OIF-OEF Service men and Women." *Contemporary Clinical Trials* 32 (1): 122–128. doi:10.1016/j.cct.2010.10.003.
- Guan, Jiancheng, and Ying He. 2007. "Patent-Bibliometric Analysis on the Chinese Science – Technology Linkages." *Scientometrics* 72 (3): 403–425. doi:10.1007/S11192-007-1741-1.
- Heeks, Richard, Christopher Foster, and Yanuar Nugroho. 2014. "New Models of Inclusive Innovation for Development." *Innovation and Development* 0 (0): 1–11. doi:10.1080/2157930X.2014.928982.
- Hu, Zhaoguang, Jiahai Yuan, and Zheng Hu. 2011. "Study on China's Low Carbon Development in an Economy–Energy–Electricity–Environment Framework." *Energy Policy* 39 (5): 2596–2605. doi:10.1016/J.ENPOL.2011.02.028.
- Huq, Nafisa Lira, Asrafi Jahan Azmi, M. A. Quaiyum, and Shahed Hossain. 2014. "Toll Free Mobile Communication: Overcoming Barriers in Maternal and Neonatal Emergencies in Rural Bangladesh." *Reproductive Health* 11 (1): 52. doi:10.1186/1742-4755-11-52.

- Jean, Ruey Jer “Bryan”, Rudolf R. Sinkovics, and Thomas P. Hiebaum. 2014. “The Effects of Supplier Involvement and Knowledge Protection on Product Innovation in Customer–Supplier Relationships: A Study of Global Automotive Suppliers in China.” *Journal of Product Innovation Management* 31 (1): 98–113. doi:[10.1111/JPIM.12082](https://doi.org/10.1111/JPIM.12082).
- Jiang, Kejun, Xing Zhuang, Ren Miao, and Chenmin He. 2013. “China’s Role in Attaining the Global 2°C Target.” *Climate Policy* 13: 55–69. doi:[10.1080/14693062.2012.746070](https://doi.org/10.1080/14693062.2012.746070).
- Jin, Wei, Heng-quan Zhang, Shuang-shuang Liu, and Hong-bo Zhang. 2019. “Technological Innovation, Environmental Regulation, and Green Total Factor Efficiency of Industrial Water Resources.” *Journal of Cleaner Production* 211: 61–69. doi:[10.1016/J.JCLEPRO.2018.11.172](https://doi.org/10.1016/J.JCLEPRO.2018.11.172).
- Kawonga, Mary, and Sharon Fonn. 2008. “Achieving Effective Cervical Screening Coverage in South Africa through Human Resources and Health Systems Development.” *Reproductive Health Matters* 16 (32): 32–40. doi:[10.1016/S0968-8080\(08\)32403-3](https://doi.org/10.1016/S0968-8080(08)32403-3).
- Koksai, Mehmet Haluk. 2016. “The Intentions of Lebanese Consumers to Adopt Mobile Banking.” *International Journal of Bank Marketing* 34 (3): 327–346. doi:[10.1108/IJBM-03-2015-0025](https://doi.org/10.1108/IJBM-03-2015-0025).
- Kraemer-Mbula, Erika, Edward Lorenz, Lotta Takala-Greenish, Oluseye Oladayo Jegede, Tukur Garba, Musambya Mutambala, and Timothy Esemu. 2019. “Are African Micro- and Small Enterprises Misunderstood? Unpacking the Relationship between Work Organisation, Capability Development and Innovation.” *International Journal of Technological Learning, Innovation and Development* 11 (1): 1. doi:[10.1504/IJTLLD.2019.097411](https://doi.org/10.1504/IJTLLD.2019.097411).
- Kraemer-Mbula, Erika, and Watu Wamae. 2010. “Innovation and the Development Agenda.” *Innovation and the Development Agenda* 9789264088. doi:[10.1787/9789264088924-en](https://doi.org/10.1787/9789264088924-en).
- Kraemer-Mbula, Erika, and Sacha Wunsch-Vincent. 2016. *The Informal Economy in Developing Nations - Hidden Engine of Innovation?* Cambridge University Press. doi:[10.1017/CBO9781316662076](https://doi.org/10.1017/CBO9781316662076).
- Kumaraswamy, Arun, Ram Mudambi, Haritha Saranga, and Arindam Tripathy. 2012. “Catch-up Strategies in the Indian Auto Components Industry: Domestic Firms Responses to Market Liberalization.” *Journal of International Business Studies* 43 (4): 368–395. doi:[10.1057/jibs.2012.4](https://doi.org/10.1057/jibs.2012.4).
- Lall, Sanjaya. 1987. *Learning to Industrialize*. Palgrave Macmillan UK. doi:[10.1007/978-1-349-18798-0](https://doi.org/10.1007/978-1-349-18798-0).
- Landström, H., G. Harirchi, and F. Åström. 2012. “Entrepreneurship: Exploring the Knowledge Base.” *Research Policy* 41 (7): 1154–1181. doi:[10.1016/j.respol.2012.03.009](https://doi.org/10.1016/j.respol.2012.03.009).
- Lema, Adrian, and Rasmus Lema. 2013. “Technology Transfer in the Clean Development Mechanism: Insights from Wind Power.” *Global Environmental Change* 23 (1): 301–313. doi:[10.1016/j.gloenvcha.2012.10.010](https://doi.org/10.1016/j.gloenvcha.2012.10.010).
- Li, Bin, and Shusheng Wu. 2017. “Effects of Local and Civil Environmental Regulation on Green Total Factor Productivity in China: A Spatial Durbin Econometric Analysis.” *Journal of Cleaner Production* 153: 342–353. doi:[10.1016/J.JCLEPRO.2016.10.042](https://doi.org/10.1016/J.JCLEPRO.2016.10.042).
- Liu, Xiyang, Boqiang Lin, and Yanjiang Zhang. 2016. “Sulfur Dioxide Emission Reduction of Power Plants in China: Current Policies and Implications.” *Journal of Cleaner Production* 113: 133–143. doi:[10.1016/J.JCLEPRO.2015.12.046](https://doi.org/10.1016/J.JCLEPRO.2015.12.046).
- Lorentzen, Jo. 2010. “Low Income Countries and Innovation Studies: A Review of Recent Literature.” *African Journal of Science and Technology, Innovation and Development* 2 (3): 46–81.
- Malik, Nishtha, Rajib Lochan Dhar, and Subhash Chander Handa. 2016. “Authentic Leadership and its Impact on Creativity of Nursing Staff: A Cross Sectional Questionnaire Survey of Indian Nurses and Their Supervisors.” *International Journal of Nursing Studies* 63: 28–36. doi:[10.1016/j.ijnurstu.2016.08.004](https://doi.org/10.1016/j.ijnurstu.2016.08.004).
- Martin, Ben R. 2012. “The Evolution of Science Policy and Innovation Studies.” *Research Policy* 41 (7): 1219–1239. doi:[10.1016/j.respol.2012.03.012](https://doi.org/10.1016/j.respol.2012.03.012).
- Masood, Mariam, and Bilal Afsar. 2017. “Transformational Leadership and Innovative Work Behavior among Nursing Staff.” *Nursing Inquiry* 24 (4). doi:[10.1111/nin.12188](https://doi.org/10.1111/nin.12188).

- Mittal, Swati, and Rajib Lochan Dhar. 2015. "Transformational Leadership and Employee Creativity: Mediating Role of Creative Self-Efficacy and Moderating Role of Knowledge Sharing." *Management Decision* 53 (5): 894–910. doi:10.1108/MD-07-2014-0464.
- Ockwell, David G., Jim Watson, Gordon MacKerron, Prosanto Pal, and Farhana Yamin. 2008. "Key Policy Considerations for Facilitating Low Carbon Technology Transfer to Developing Countries." *Energy Policy* 36 (11): 4104–4115. doi:10.1016/j.enpol.2008.06.019.
- Pansera, Mario. 2013. "Frugality, Grassroots and Inclusiveness: New Challenges for Mainstream Innovation Theories." *African Journal of Science, Technology, Innovation and Development* 5 (6): 469–478. doi:10.1080/20421338.2013.820445.
- Pansera, Mario, and Fabien Martinez. 2017. "Innovation for Development and Poverty Reduction: An Integrative Literature Review." *Journal of Management Development* 36 (1): 2–13. doi:10.1108/JMD-02-2015-0013.
- Peng, Bin-Bin, Jin-Hua Xu, and Ying Fan. 2018. "Modeling Uncertainty in Estimation of Carbon Dioxide Abatement Costs of Energy-Saving Technologies for Passenger Cars in China." *Energy Policy* 113: 306–319. doi:10.1016/J.ENPOL.2017.11.010.
- Pérez, Carlota, Anabel Marín, and Lizbeth Navas-alemán. 2014. "The Possible Dynamic Role of Natural Resource-Based Networks in Latin American Development Strategies." In *National Innovation Systems, Social Inclusion and Development*, 380–412. Edward Elgar Publishing. doi:10.4337/9781782548683.00018.
- Prasad, Shambu. 2016. "Innovating at the Margins: The System of Rice Intensification in India and Transformative Social Innovation." *Ecology and Society* 21 (4). doi:10.5751/ES-08718-210407.
- Pugh, Rhiannon, and Tulio Chiarini. 2018. "Innovation Studies: A North–South Global Perspective." *Innovation and Development* 8 (2): 227–248. doi:10.1080/2157930X.2017.1365150.
- Qi, Jiayin, Ling Li, Yuanquan Li, and Huaying Shu. 2009. "An Extension of Technology Acceptance Model: Analysis of the Adoption of Mobile Data Services in China." *Systems Research and Behavioral Science* 26 (3): 391–407. doi:10.1002/SRES.964.
- Roberton, Timothy, Jennifer Applegate, Amnesty E. Lefevre, Idda Mosha, Chelsea M. Cooper, Marissa Silverman, Isabelle Feldhaus, et al. 2015. "Initial Experiences and Innovations in Supervising Community Health Workers for Maternal, Newborn, and Child Health in Morogoro Region, Tanzania." *Human Resources for Health* 13 (1): 19. doi:10.1186/s12960-015-0010-x.
- Rodima-Taylor, Daivi. 2012. "Social Innovation and Climate Adaptation: Local Collective Action in Diversifying Tanzania." *Applied Geography* 33 (1): 128–134. doi:10.1016/J.APGEOG.2011.10.005.
- Sasidharan, Subash, and Vinish Kathuria. 2011. "Foreign Direct Investment and R&D: Substitutes or Complements—A Case of Indian Manufacturing After 1991 Reforms." *World Development* 39 (7): 1226–1239. doi:10.1016/J.WORLDDEV.2010.05.012.
- Schalkwyk, Susan Van, Juanita Bezuidenhout, HOFFIE Conradie, Therese Fish, Norma Kok, Ben van Heerden, and Marietjie De Villiers. 2014. "Going Rural": Driving Change through a Rural Medical Education Innovation." *Rural and Remote Health* 14 (2). doi:10.22605/RRH2493.
- Scheffran, Jürgen, Elina Marmer, and Papa Sow. 2012. "Migration as a Contribution to Resilience and Innovation in Climate Adaptation: Social Networks and Co-Development in Northwest Africa." *Applied Geography* 33 (1): 119–127. doi:10.1016/J.APGEOG.2011.10.002.
- Shen, Neng, Haolan Liao, Rumeng Deng, and Qunwei Wang. 2019. "Different Types of Environmental Regulations and the Heterogeneous Influence on the Environmental Total Factor Productivity: Empirical Analysis of China's Industry." *Journal of Cleaner Production* 211: 171–184. doi:10.1016/J.JCLEPRO.2018.11.170.
- Singer, Hans, Charles Cooper, R. C. Desai, Christopher Freeman, Oscar Gish, Stephen Hill, and Geoffrey Oldham. 1970. *The Sussex Manifesto: Science and Technology to Developing Countries during the Second Development Decade – Catalog* (No. 101; IDS Reprints). <http://steps-centre.org/wp-content/uploads/The-Sussex-Manifesto-IDS-Reprint.pdf>.
- Steffensen, Morten, Everett M. Rogers, and Kristen Speakman. 2000. "Spin-offs from Research Centers at a Research University." *Journal of Business Venturing* 15 (1): 93–111. doi:10.1016/S0883-9026(98)00006-8.

- Theriault, Veronique, Melinda Smale, and Hamza Haider. 2017. "How Does Gender Affect Sustainable Intensification of Cereal Production in the West African Sahel? Evidence from Burkina Faso." *World Development* 92: 177–191.
- Tipu, Syed Awais Ahmad, James C. Ryan, and Kamel A. Fantazy. 2012. "Transformational Leadership in Pakistan: An Examination of the Relationship of Transformational Leadership to Organizational Culture and Innovation Propensity." *Journal of Management and Organization* 18 (4): 461–480. doi:10.5172/jmo.2012.18.4.461.
- Tittonell, Pablo, A. Muriuki, Keith D. Shepherd, D. Mugendi, K. C. Kaizzi, J. Okeyo, Louis Verchot, Richard Coe, and Bernard Vanlauwe. 2010. "The Diversity of Rural Livelihoods and Their Influence on Soil Fertility in Agricultural Systems of East Africa – A Typology of Smallholder Farms." *Agricultural Systems* 103 (2): 83–97. doi:10.1016/j.agsy.2009.10.001.
- Tseng, Chun Yao. 2009. "Technological Innovation in the BRIC Economies." *Research-Technology Management* 52 (2): 29–35. doi:10.1080/08956308.2009.11657556.
- Tung, Feng Cheng. 2016. "Does Transformational, Ambidextrous, Transactional Leadership Promote Employee Creativity? Mediating Effects of Empowerment and Promotion Focus." *International Journal of Manpower* 37 (8): 1250–1263. doi:10.1108/IJM-09-2014-0177.
- UNESCO. 2021. *UNESCO Science Report: The Race against Time for Smarter Development*. <https://unesdoc.unesco.org/ark:/48223/pf0000377433>.
- Wong, Christina W. Y., Chee Yew Wong, and Sakun Boon-Itt. 2013. "The Combined Effects of Internal and External Supply Chain Integration on Product Innovation." *International Journal of Production Economics* 146 (2): 566–574. doi:10.1016/J.IJPE.2013.08.004.
- Yang, Jin, Hefu Liu, and Jibao Gu. 2017. "A Multi-Level Study of Servant Leadership on Creativity: The Roles of Self-Efficacy and Power Distance." *Leadership & Organization Development Journal* 38 (5): 610–629. doi:10.1108/LODJ-10-2015-0229.
- Yang, Shuiqing, Yaobin Lu, Sumeet Gupta, Yuzhi Cao, and Rui Zhang. 2012. "Mobile Payment Services Adoption Across Time: An Empirical Study of the Effects of Behavioral Beliefs, Social Influences, and Personal Traits." *Computers in Human Behavior* 28 (1): 129–142. doi:10.1016/j.chb.2011.08.019.
- Zhang, Jiangxue, Yimeng Liu, Yuan Chang, and Lixiao Zhang. 2017. "Industrial Eco-Efficiency in China: A Provincial Quantification Using Three-Stage Data Envelopment Analysis." *Journal of Cleaner Production* 143: 238–249. doi:10.1016/J.JCLEPRO.2016.12.123.
- Zheng, Jia, Zhi-yun Zhao, Xu Zhang, Dar-zen Chen, and Mu-hsuan Huang. 2014. "International Collaboration Development in Nanotechnology: A Perspective of Patent Network Analysis." *Scientometrics* 98 (1): 683–702. doi:10.1007/S11192-013-1081-X.
- Zulu, Joseph Mumba, Anna-Karin Hurtig, John Kinsman, and Charles Michelo. 2015. "Innovation in Health Service Delivery: Integrating Community Health Assistants into the Health System at District Level in Zambia." *BMC Health Services Research* 15 (1): 1–12. doi:10.1186/S12913-015-0696-4.