

Corporate carbon accounting: a literature review of carbon accounting research from the Kyoto Protocol to the Paris Agreement

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Abstract

This paper describes the development of and gaps in knowledge in research on carbon accounting based on a systematic review of 117 papers published in influential accounting journals between 2005 and 2018. The review shows the literature has developed into four major streams of carbon accounting: carbon disclosure, management, performance and assurance, and that carbon accounting is emerging as a distinct discipline. Finally, our paper highlights future research opportunities to improve carbon accounting, so it can play an even more important role to help business achieve the climate goals of the Paris Agreement.

Key words: Carbon accounting; Literature review; Climate change; Corporate carbon management; Paris Agreement

JEL classification: Q56

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1. Introduction

Climate change is one of the most serious issues affecting communities and economies around the world.¹ Governments in many countries have designed and implemented various market-based and non-market-based policies to encourage companies to reduce their greenhouse gas (GHG) emissions.

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¹See the United Nations Global Issues website (<http://www.un.org/en/sections/issues-depth/global-issues-overview/>).

企业碳会计： 《京都议定书》的碳核算研究 巴黎协定

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Abstract

本文基于对2005年至2018年在有影响力的会计期刊上发表的117篇论文的系统回顾, 描述了碳会计研究的发展和知识差距。该综述表明, 文献已经发展成为碳会计的四个主要领域: 碳披露, 管理, 绩效和保证, 碳会计正在成为一门独特的学科。最后, 我们的论文强调了改善碳核算的未来研究机会, 因此它可以在帮助企业实现巴黎协定的气候目标方面发挥更重要的作用。

关键词: 碳核算; 文献综述; 气候变化; 企业碳管理; 巴黎协定

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1. Introduction

世界各地的经济体。许多国家的政府设计并实施了各种基于市场和非基于市场的政策, 以鼓励公司减少其温室气体 (GHG) 排放。

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¹见联合国全球问题网站(<http://www.un.org/sections/issues-depth/global-issues-overview/>)。

Changes in climate conditions and new carbon institutions inevitably influence corporate practices (Howard-Grenville *et al.*, 2014). It is thus not surprising that the interplay among carbon institutions, corporations and their stakeholders has attracted significant interest from academic researchers, and many papers on carbon accounting have been published in accounting journals.

The objective of the present study is to comprehensively review the research on emerging carbon accounting practice. Our intention is to help researchers understand the current status of the carbon accounting literature and guide future development in this area. Currently there are three reviews of carbon accounting in the accounting literature: Hartmann *et al.* (2013), Ascui (2014) and Borghei (2021). These reviews have their limitations.² First, none of the reviews is comprehensive. Hartmann *et al.* (2013) only review a few key papers, and their discussion of future research focuses on carbon management and control. Ascui (2014) covers just eight journals, including one non-accounting journal (namely, the *Journal of Cleaner Production*). Borghei (2021) focuses on only carbon disclosure. Second, Hartmann *et al.* (2013) and Ascui (2014) only cover papers published in years to 2013. Thus, they miss recent developments in carbon accounting research. In contrast, our review covers a wide range of accounting journals and topics within carbon accounting and includes papers published up to the end of 2018. With our comprehensive literature review, we hope to present a full picture of the current carbon accounting research.

For the purpose of this literature review, we adopt the information-perspective definition of carbon accounting proposed by Tang (2017), which defines carbon accounting as 'a system that uses accounting methods and procedures to collect, record, and analyse climate change-related information and account for and report carbon-related assets, liabilities, expenses, and income to inform the decision-making processes of internal managers and external stakeholders' (Tang, 2017, p. 11). Based on this definition, we identify carbon accounting publications through a keyword search of the Business Solution Ultimate, ScienceDirect and Scopus databases. After computer-aided and manual screening, we select 117 papers published in quality accounting journals as the source data for this review.

An analysis of publication trends in carbon accounting shows that the initiation and evolution of carbon accounting research and practice are synchronised with the development of global carbon institutions. Early publications in the carbon accounting literature can be traced back to the publication of Freedman and Jaggi (2005), which happened to coincide with the inception of the European Union (EU) Emission Trading Scheme (ETS). Since then, a significant number of conceptual or empirical works have been published in various accounting journals to provide opinions, insights and

²There are literature reviews on carbon accounting in other disciplines; for example, Stechemesser and Guenther (2012) on definition of carbon accounting and Hahn *et al.* (2015) on carbon disclosure.

气候条件的变化和新的碳机制不可避免地影响企业实践(Howard-Grenville et al. 2014)。因此，碳排放机构、公司及其股东之间的相互作用引起了学术研究人员的极大兴趣，许多关于碳排放会计的论文已经发表在会计期刊上，这一点也就不足为奇了。

本研究的目的是全面回顾新兴碳核算实践的研究。我们的目的是帮助研究人员了解碳会计文献的现状，并指导这一领域的未来发展。目前会计文献中有三篇关于碳会计的评论：Hartmann et al. (2013)，Ascui (2014) 和 Borghei (2021)。这些评论有其局限性。首先，没有一个评论是全面的。哈特曼等人。(2013)只回顾了几篇关键论文，他们对未来的讨论集中在碳管理和控制上。Ascui (2014)仅涵盖八种期刊，包括一种非会计期刊（即清洁生产期刊）。Borghei (2021)只关注碳披露。其次，Hartmann等人。(2013年)和Ascui (2014年)只涵盖到2013年发表的论文。因此，他们错过了碳核算研究的最新发展。相比之下，我们的评论涵盖了碳会计领域的广泛会计期刊和主题，包括截至2018年底发表的论文。通过我们全面的文献综述，我们希望能够全面介绍当前的碳核算研究。

在这篇文献综述中，我们采用了Tang (2017)提出的碳核算的信息视角定义，该定义将碳核算定义为“一种使用会计方法和程序收集、记录和分析气候变化相关信息、核算和报告碳相关资产、负债、费用和收入，为内部管理人员和外部利益相关者的决策过程提供信息的系统”(Tang, 2017, 第11页)。基于此定义，我们通过BusinessSolutionUltimate、ScienceDirect和Scopus数据库的关键字搜索来识别碳会计出版物。经过计算机辅助和人工筛选，我们选择了117篇发表在质量会计期刊上的论文作为本次审查的来源数据。

碳核算的出版趋势分析表明，碳核算研究和实践的发起和演变与全球碳制度的发展是同步的。碳核算文献的早期出版物可以追溯到Freedman和Jaggi (2005)的出版，这恰好与欧盟(EU)排放交易计划(ETS)的成立相吻合。此后，大量的概念性或实证性著作在各种会计期刊上发表，提供意见、见解和

2在其他学科中有关于碳核算的文献综述；例如，Stechemesser和Guenther(2012)和Hahn et al. (2015)关于碳披露。

evidence on carbon accounting. The development of the carbon accounting research corresponds to the development of global carbon legislation, low-carbon investment and corporate carbon disclosure.

We find that studies on corporate carbon accounting focus mainly on the following: accounting for carbon assets and liabilities, carbon disclosure, carbon assurance, carbon management, carbon performance and the impact of carbon issues on the capital market. Of these areas, carbon disclosure is the most extensively studied. Researchers discuss the quality of voluntary carbon disclosure and identify a number of facts external and internal to the firm that affect corporate carbon disclosure. Here we summarise the contributions and limitations of the current carbon accounting research, outline emerging research trends, highlight opportunities to integrate and expand on existing knowledge, as well as discuss avenues for further investigation of corporate carbon accounting.

The remainder of this paper is organised as follows. Section 2 provides an overview of the carbon accounting papers examined and describes publication trends in carbon accounting research in accounting journals. Section 3 provides a detailed review of the carbon accounting research, focusing on corporate practices for dealing with climate change, the drivers behind these practices, as well as their consequences. Section 4 summarises the contributions and limitations of prior carbon accounting studies and suggests future research directions. Section 5 concludes the paper.

2. Method and descriptive analysis

2.1. Literature search

The literature search involves three main steps. First, a general keyword search is performed in three major journal databases: Business Solution Ultimate, ScienceDirect and Scopus. The keywords are selected based on the definition of carbon accounting discussed earlier to reflect the two essential elements of carbon accounting research: relating to climate change; and relating to management, accounting, accountability or stakeholders. Thus, we choose two groups of keywords. The first group includes seven keywords related to climate change: *climate change, global warming, carbon, greenhouse, GHG, emission** and *ETS*. The second group includes eight business-related keywords: *account*, manage*, finance*, assur*, audit*, disclos*, report* and valu**. The search is based on 56 possible phrases, each combining one climate change keyword and one business keyword with the Boolean operator *AND* in between. We limit keyword matching to the abstract, title or keyword if the database provides this functionality; otherwise, keyword matching is based on the full text. The search results are imported into EndNote, and duplicate papers are deleted. The search returns 11,112 unique records from 1,372

碳核算的证据。碳核算研究的发展与全球碳立法、低碳投资和公司碳披露的发展相对应。

我们发现，关于企业碳会计的研究主要集中在以下方面：碳资产和负债的会计、碳披露、碳保证、碳管理、碳绩效和碳问题对资本市场的影响。在这些领域中，碳披露是研究最广泛的。研究人员讨论了自愿碳披露的质量，并确定了一些影响公司碳披露的外部和内部事实。在这里，我们总结了目前碳会计研究的贡献和局限性，概述了新的研究趋势，强调了整合和扩展现有知识的机会，并讨论了进一步研究公司碳会计的途径。

本文的其余部分组织如下。第2节概述了碳会计论文的审查和描述了碳会计研究在会计期刊上的发表趋势。第3节详细回顾了碳核算研究，重点介绍了应对气候变化的公司做法、这些做法背后的驱动因素及其后果。第4节总结了以往碳核算研究的贡献和局限性，并提出了未来的研究方向。第5节总结了这篇论文。

2.方法和描述性分析

2.1.文献检索

文献检索涉及三个主要步骤。首先，在三个主要期刊数据库中执行一般关键字搜索：BusinessSolutionUltimate, ScienceDirect和Scopus。这些关键词是根据前面讨论的碳核算定义选择的，以反映碳核算研究的两个基本要素：与气候变化有关；与管理、会计、问责制或利益相关者有关。因此，我们选择两组关键字。第一组包括与气候变化相关的七个关键字：气候变化，全球变暖，碳，温室，GHG，排放*和ETS。第二组包括八个与业务相关的关键字：帐户*，管理*，财务*，财务*，审计*，披露*，报告*和valu*。搜索基于56个可能的短语，每个短语都将一个气候变化关键字和一个商业关键字与布尔运算符结合在一起。如果数据库提供此功能，我们将关键字匹配限制为摘要，标题或关键字；否则，关键字匹配基于全文。搜索结果导入EndNote，重复的论文被删除。搜索返回来自1 372条的11 112条唯一记录

journals. These journals cover a wide range of research disciplines, including accounting, business, economics, science, engineering, politics and law.

Second, the search results are screened by journal. To include only papers published in high-quality accounting journals, we rely on the Australian Business Dean Council (ABDC) journal list for this screening. The ABDC is the 'collective voice of university pro vice-chancellors, executive deans and heads of Australian business faculties and schools' representing 39 university faculties and schools in Australia. The council publishes a journal quality list that rates more than 2,700 research journals across 16 business-related areas as A*, A, B or C, with A* representing journals of the highest quality. This list is commonly used by member universities as a benchmark for evaluating the research performance of their staff. This review focuses on journals with an A*, A or B rating, which can be largely matched to Association of Business School Academic Journal Guide 2015 (ABS) rankings 4, 3 and 2, respectively.³ This screening process narrows the sample to 621 papers published in accounting journals.

Third, a final manual screen is conducted to exclude papers with little relevance to corporate carbon accounting. Specifically, we exclude papers that focus on issues other than climate change as well as papers that are related to climate change but irrelevant to corporations. The final sample consists of 117 papers on carbon accounting published in 34 influential accounting journals from 2005 to December 2018.⁴

2.2. Descriptive analysis

Table 1 presents the list of journals in which the selected papers are published. The table organises the journals according to their ABDC rating and also shows their corresponding Association of Business School Academic Journal Guide 2015 ranking. In the A* group (2018 rating), *Accounting, Organizations and Society* has the most carbon accounting papers (5 papers), followed by *European Accounting Review* (4). In the A group, *Accounting, Auditing and Accountability Journal* has the most papers (18). It is also the journal with the most publications across the entire sample. *British Accounting Review* ranks second (8) in this group in terms of the number of publications. In

³For more information on the review process for the ABDC journal list, see <http://www.abdc.edu.au/pages/2016-review.html>.

⁴Some carbon accounting papers published in non-accounting journals are identified in the search process. For example, through the end of 2018, 20 papers were published in the *Journal of Business Ethics* and four papers were published in the *Journal of Cleaner Production*. These papers concern carbon disclosure, carbon risk management, supply chain carbon management, and carbon strategy and management. Although these papers are not included in this review, we acknowledge their contribution to the literature.

期刊。这些期刊涵盖广泛的研究学科，包括会计、商业、经济、科学、工程、政治和法律。

二、检索结果按期刊筛选。为了只包括在高质量会计期刊上发表的论文，我们依靠澳大利亚商业院长委员会（ABDC）期刊名单进行这次筛选。ABDC是代表澳大利亚39所大学学院和学校的“大学副校长、行政院长和澳大利亚商学院和学校负责人的集体声音”。该委员会出版了一份期刊质量清单，将16个与商业有关的领域的2 700多份研究期刊评为A*、A、B或C，其中A*代表最高质量的期刊。这份名单通常被成员大学用作评估其员工研究表现的基准。这篇评论的重点是具有A*、A或B评级的期刊，这些期刊可以在很大程度上与商学院学术期刊指南协会2015（ABS）排名4、3和2分别相匹配。3这一筛选过程将样本缩小到在会计期刊上发表的621篇论文。

第三，进行最后的手动筛选，以排除与公司碳会计无关的论文。具体来说，我们排除了关注气候变化以外问题的论文，以及与气候变化有关但与公司无关的论文。最终样本包括2005年至2018年12月在34份有影响力的会计期刊上发表的117篇关于碳会计的论文。⁴

2.2. 描述性分析

表1列出了所选论文发表的期刊列表。该表根据其ABDC评级组织期刊，并显示其相应的商学院学术期刊指南协会2015排名。在A*组（2018评级）中，会计、组织和社会的碳会计论文最多（5论文），其次是欧洲会计评论（4）。在A组中，会计、审计和问责期刊的论文最多（18）。它也是整个样本中出版物最多的期刊。就出版物数量而言，英国会计评论在该组中排名第二（8）。在

³有关ABDC期刊列表的审查过程的更多信息，请参阅<http://www.abdc.edu.au>第2016页-回顾.html。

⁴在非会计期刊上发表的一些碳会计论文在检索过程中被识别。例如，截至2018年底，《商业伦理杂志》发表了20篇论文，《清洁生产杂志》发表了4篇论文。这些论文涉及碳披露、碳风险管理、供应链碳管理以及碳战略和管理。虽然这些论文不包括在这篇综述中，但我们承认他们对文献的贡献。

Table 1
Journals in which carbon accounting papers are published (2005–2018)

No.	ABDC rating (2016)	Journal Title	ABS 2015 ranking	Number of papers	Total
1	A*	<i>Accounting, Organizations and Society</i>	4*	5	
2		<i>Auditing: A Journal of Practice and Theory</i>	3	3	
3		<i>Contemporary Accounting Research</i>	4	1	
4		<i>European Accounting Review</i>	3	4	
5		<i>The Accounting Review</i>	4*	2	
6	A	<i>Abacus: A Journal of Accounting, Finance and Business Studies</i>	3	2	15
7		<i>Accounting and Finance</i>	2	5	
8		<i>Accounting and Business Research</i>	3	2	
9		<i>Accounting Horizons</i>	3	2	
10		<i>Accounting, Auditing and Accountability Journal</i>	3	18	
11		<i>British Accounting Review</i>	3	8	
12		<i>Critical Perspectives on Accounting</i>	3	4	
13		<i>Financial Accountability and Management</i>	3	1	
14		<i>International Journal of Auditing</i>	2	1	
15		<i>Journal of Accounting and Public Policy</i>	3	3	
16		<i>Journal of Accounting, Auditing and Finance</i>	3	1	
17		<i>Journal of Business Finance and Accounting</i>	3	1	
18		<i>Journal of Contemporary Accounting and Economics</i>	2	2	
19		<i>Journal of International Accounting Research</i>	2	2	
20		<i>The International Journal of Accounting</i>	3	4	56
21	B	<i>Accounting and the Public Interest</i>	2	1	
22		<i>Accounting Forum</i>	3	6	
23		<i>Accounting in Europe</i>	2	2	
24		<i>Accounting Research Journal</i>	2	5	
25		<i>Asian Review of Accounting</i>	2	1	
26		<i>Australian Accounting Review</i>	2	10	
27		<i>Current Issues in Auditing</i>	2	1	
28		<i>International Journal of Accounting and Information Management</i>	2	1	
29		<i>Journal of Accounting and Organizational Change</i>	2	1	
30		<i>Journal of International Financial Management and Accounting</i>	2	1	
31		<i>Managerial Auditing Journal</i>	2	3	
32		<i>Pacific Accounting Review</i>	1	2	
33		<i>Social and Environmental Accountability Journal</i>	1	5	
34		<i>Sustainability Accounting, Management and Policy Journal</i>	2	7	46
		Total		117	117

ABDC 2016, Australian Business Dean Council; ABS AJG 2015, Association of Business School Academic Journal Guide 2015.

Table 1
碳会计论文发表期刊(2005–2018)

No.	ABDC rating	期刊名称	ABSAJG20 15年排名	论文数 量	Total
1	A*	会计、组织与社会	4*	5	
2		审计：实践与理论杂志	3	3	
3		当代会计研究	4	1	
4		欧洲会计评论	3	4	
5		会计检讨	4*	2	
6	A	Abacus:会计、金融和金融杂志 商业研究	3	2	15
7		会计与财务	2	5	
8		会计及商业研究	3	2	
9		会计专业	3	2	
10		会计、审计和问责期刊	3	18	
11		英国会计评论	3	8	
12		会计的批判性观点	3	4	
13		财务问责和管理	3	1	
14		国际审计杂志	2	1	
15		会计与公共政策杂志	3	3	
16		会计、审计与财务杂志	3	1	
17		商业金融和会计杂志	3	1	
18		当代会计与 <i>Economics</i>	2	2	
19		国际会计研究杂志	2	2	
20		国际会计杂志	3	4	56
21	B	会计与公共利益	2	1	
22		会计论坛	3	6	
23		欧洲的会计	2	2	
24		会计研究期刊	2	5	
25		亚洲会计评论	2	1	
26		澳大利亚会计评论	2	10	
27		审计中的当前问题	2	1	
28		国际会计杂志及 资讯管理	2	1	
29		会计与组织变革杂志	2	1	
30		国际财务管理与会计杂志	2	1	
31		管理审计杂志	2	3	
32		太平洋会计评论	1	2	
33		社会及环境责任杂志	1	5	
34		可持续发展会计、管理及 政策杂志	2	7	46
Total			117	117	

ABDC2016, 澳大利亚商业院长理事会;ABSAJG2015, 商业协会学校学术期刊指南2015。

the B group, *Australian Accounting Review* and *Sustainability Accounting, Management and Policy Journal* are on top with 10 and 7 papers, respectively. On average, each journal publishes 3.44 papers (117/34). The average number of publications is 3 (15/5) in A* journals, 3.73 (56/15) in A journals and 3.28 (46/14) in B journals.

Table 2 summarises the distribution of publications over the period 2005–2018, and Figure 1 visualises the trend in publication. The number of publications on carbon accounting increases sharply from 2005 to 2011 and then becomes stable from 2012 to 2018. Next, we classify the publications by methodology: conceptual, qualitative empirical or quantitative empirical. Table 3 and Figure 2 show the distribution of papers across these three categories.

The emergence and development of carbon accounting research represent the response of accounting academics to the challenge of climate change. Figure 3 illustrates how this response resonates and corresponds with the responses of other groups and communities in society to climate change. In particular, similar increasing patterns exist in the amount of carbon legislation enacted, the amount of green investment, the number of companies that voluntarily participate in the CDP survey, and the number of publications on carbon

Table 2
Publications by year

Rating	Number of publications			
	A*	A	B	Total
Year				
2005		1		1
2006				
2007				
2008	3			3
2009	5†	2		7
2010		2	4	6
2011		4	7	15
2012		7		11
2013		8		13
2014	1	3	7	11
2015	2	7	2	11
2016	3	6	4	13
2017	1	8	3	12
2018		7	7	14
Total	15	56	46	117

†All five papers were published in a special issue of *Accounting, Organizations and Society*.

‡Includes eight papers published in a special issue of *Accounting, Auditing and Accountability Journal*.

Bgroup, *Australian Accounting Review* and *Sustainability Accounting, Management and Policy Journal* 分别以10和7论文位居榜首。平均每个期刊发表3.44篇论文（117/34）。A*期刊的平均出版物数量为3（155），A期刊为3.73（56/15），B期刊为3.28（46/14）。

表2总结了2005–2018年期间出版物的分布情况，图1显示了出版物的趋势。关于碳核算的出版物数量从2005年到2011年急剧增加，然后从2012年到2018年变得稳定。接下来，我们通过方法论对出版物进行分类：概念，定性经验或定量经验。表3和图2显示了这三类论文的分布情况。

碳会计研究的出现和发展代表了会计学界对气候变化挑战的反应。图3说明了这种反应如何与社会上其他群体和社区对气候变化的反应产生共鸣和对应。特别是，在颁布的碳立法数量，绿色投资数量，自愿参与CDP调查的公司数量以及关于碳的出版物数量方面，也存在类似的增长模式。

Table 2
按年分类的刊物

Rating	刊物数目			
	A*	A	B	Total
Year				
2005			1	1
2006				
2007				
2008	3			3
2009	5†	2		7
2010		2	4	6
2011		4	7	15
2012		7		11
2013		8		13
2014	1	3	7	11
2015	2	7	2	11
2016	3	6	4	13
2017	1	8	3	12
2018		7	7	14
Total	15	56	46	117

†所有五篇论文都发表在会计、组织和社会的特刊上。*包括八篇发表在《会计、审计和问责杂志》特刊上的论文。

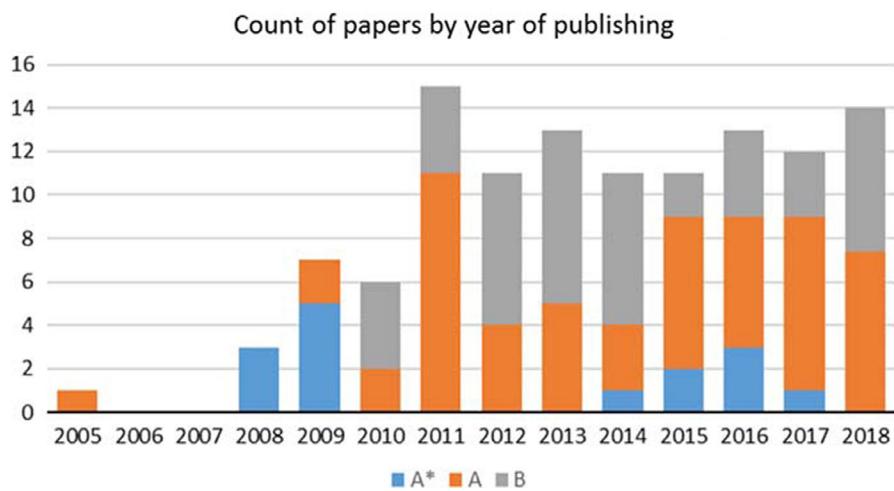


Figure 1 Number of publications by year. [Colour figure can be viewed at wileyonlinelibrary.com]

Table 3
Publications by research methodology

Rating	Number of publications			
	A*	A	B	Total
Methodology				
Conceptual	5	13	12	30
Qualitative empirical	2	11	10	23
Quantitative empirical	8	32	24	64
Total	15	56	46	117

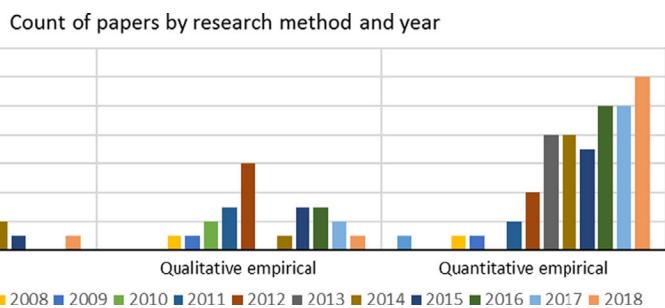


Figure 2 Distribution of publications by research methodology. [Colour figure can be viewed at wileyonlinelibrary.com]

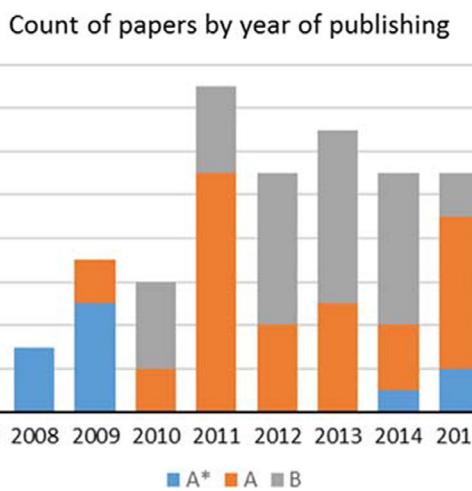


Figure 1 按年分类的出版物数量。[颜色图可于wileyonlinelibrary.com]

Table 3
按研究方法出版的刊物

Rating	刊物数目			
	A*	A	B	Total
Methodology				
Conceptual	5	13	12	30
定性实证	2	11	10	23
定量经验	8	32	24	64
Total	15	56	46	117

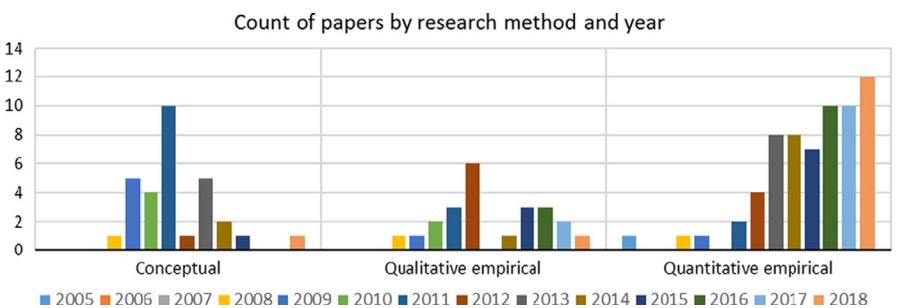


Figure 2 按研究方法分发出版物。[颜色图可于wileyonlinelibrary.com]

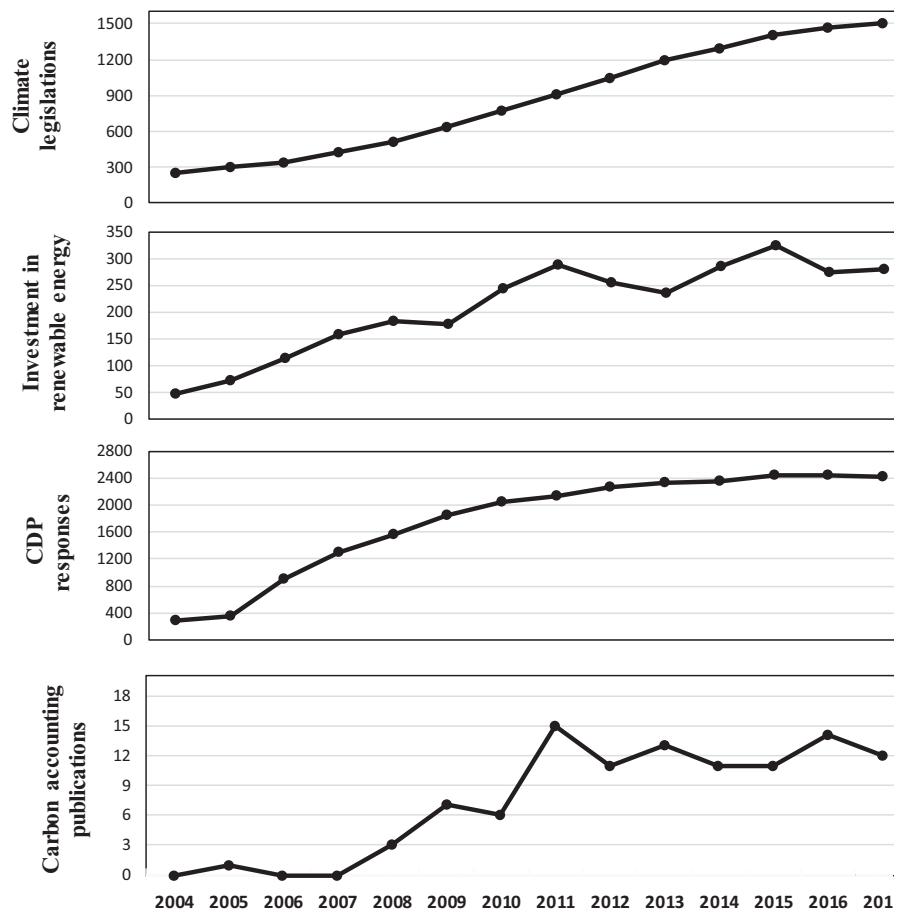


Figure 3 Synchronisation of responses to climate change.

Data sources:

Climate legislation: The Grantham Research Institute on Climate Change and the Environment.
<http://www.lse.ac.uk/GranthamInstitute/climate-change-laws-of-the-world/?region=all&country=a ll&fromyear=all&toyear=all&emitter=all&income=all&framework=all&execleg=all&category=a ll&type=law>

Investment in renewable energy: UN Environment's Economy Division, Frankfurt School-UNEP
Collaborating Centre for Climate & Sustainable Energy Finance, and Bloomberg New Energy

Finance, 2018, Global trends in renewable energy investment 2018.<http://www.greengrowthknowledge.org/resource/global-trends-renewable-energy-investment-report-2018>.

CDP responses: CDP database.

Carbon accounting publications: this study.

accounting from 2004 to 2018. These patterns reflect the concurrent activity of legislators, investors, corporations and academics, respectively. It appears that social actors respond to climate change in an interactive manner and reinforce one another.

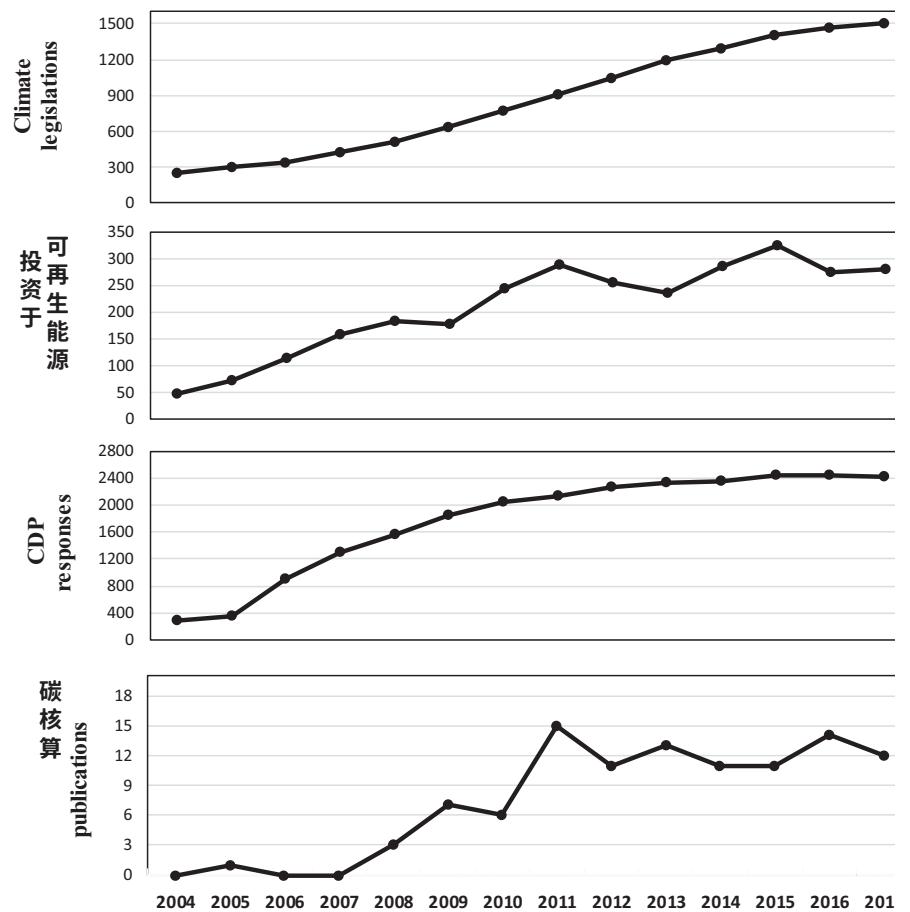


Figure 3 同步应对气候变化。

Data sources:

气候立法：格兰瑟姆气候变化与环境研究所。<http://www.lse.ac.uk/GranthamInstitute/climate-change-law-of-the-world?region=all&country=all&fromyear=all&toyear=all&emitter=all&income=all&framework=all&execleg=all&category=all&type=lawInvestmentinrenewableenergy:UnEnvironment'SEconomyDivisionFrankfurtSchool-UNEP>

气候与可持续能源金融合作中心及彭博新能源

金融 2018 全球可再生能源投资趋势2018.http://www.ngrowthknowledge.org资源全球-趋势-可再生能源-投资-报告-2018.CDP响应:CDP数据库.

碳会计出版物：这项研究。

会计从2004年到2018年。这些模式分别反映了立法者、投资者、公司和学者的同时活动。社会行动者似乎以互动的方式应对气候变化，并相互加强。

Next, we examine the shift in methodology in the carbon accounting literature. Conceptual papers are dominant in the early development of the literature until 2011. Empirical studies gain in popularity beginning in 2012. In particular, the number of quantitative studies increases steadily beginning in 2014, possibly owing to the increased accessibility and availability of carbon-related data.

In sum, our descriptive analysis of the papers identifies a few features of the carbon accounting literature. First, carbon accounting studies are published in a wide range of accounting journals. Second, the increase in the publication of carbon accounting papers in accounting journals is synchronised with trends in carbon legislation, green investment and corporate carbon disclosure. Finally, the methodology used in carbon accounting research has largely shifted from conceptual to empirical study, especially quantitative empirical study.

3. The carbon accounting literature

The Kyoto Protocol established the carbon market as a market-based mechanism for reducing or limiting GHG emissions in ratifying countries. The formation of the carbon emissions trading market created accounting issues that had never before been considered. The new mechanism aroused critical discussion and debate in the accounting literature on the nature and effectiveness of various climate change policies (Callon, 2009; Andrew *et al.*, 2010; Boston and Lempp, 2011; Carter *et al.*, 2011; McNicholas and Windsor, 2011; Lodhia and Martin, 2012a; Andrew and Cortese, 2013). For example, carbon markets are considered ‘on-going collective experiments’ that redefine ‘the forms of organization of economic, political and scientific activities’ (Callon, 2009, p. 549). Moreover, the process of setting climate change policy is regarded as highly political (Boston and Lempp, 2011; Carter *et al.*, 2011; Andrew and Cortese, 2013), and doubt has been cast on the effectiveness of various climate change policies for reducing GHG emissions (Callon, 2009; Andrew *et al.*, 2010; McNicholas and Windsor, 2011).

Although the policy debate considers the impact of climate change on business at the macro level, some scholars seek to identify the specific accounting implications of climate change and discuss the challenges to carbon accounting in terms of both research and practice (e.g., Bebbington and Larrinaga-González, 2008; Hopwood, 2009). In particular, they discuss financial accounting and reporting issues related to carbon trading as well as ways in which accounting may be involved in communicating climate risks and uncertainties. Hartmann *et al.* (2013) extend this discussion and explicate carbon accounting from a management accounting perspective to promote research in carbon management and control. These early conceptual studies outline the opportunities and challenges for later carbon accounting research.

接下来，我们研究了碳会计文献中方法论的转变。概念论文在文献的早期发展中占主导地位，直到2011年。实证研究从2012年开始流行起来。特别是，定量研究的数量从2014年开始稳步增加，这可能是由于碳相关数据的可访问性和可用性增加。

总之，我们对论文的描述性分析确定了碳核算文献的一些特征。首先，碳会计研究发表在广泛的会计期刊上。其次，在会计期刊上发表碳会计论文的增加与碳立法、绿色投资和公司碳披露的趋势同步。最后，碳核算研究中使用的方法在很大程度上已经从概念研究转向实证研究，特别是定量实证研究。

3. 碳会计文献

《京都议定书》将碳市场确立为在批准国减少或限制温室气体排放的基于市场的机制。碳排放交易市场的形成产生了以前从未考虑过的会计问题。新机制在会计文献中引起了关于各种气候变化政策的性质和有效性的批判性讨论和辩论 (Callon, 2009; Andrew等人。, 2010; Boston和Lempp, 2011; Carter等人。, 2011; McNicholas和Windsor, 2011; Lodhia和Martin, 2012a; Andrew和Cortese, 2013)。例如，碳市场被认为是“正在进行的集体实验”，重新定义“经济，政治和科学活动的组织形式” (Callon, 2009, p.549)。此外，制定气候变化政策的过程被认为是高度政治性的 (Boston和Lempp, 2011; Carter等人。, 2011; Andrew和Cortese, 2013)，并且对各种气候变化政策减少温室气体排放的有效性产生了怀疑 (Callon, 2009; Andrew等人。, 2010; McNicholas和Windsor, 2011)。

虽然政策辩论从宏观层面考虑了气候变化对商业的影响，但一些学者寻求确定气候变化的具体会计影响，并从研究和实践的角度讨论碳会计的挑战（例如，Bebbington和Larrinaga-González, 2008; Hopwood, 2009）。特别是，他们讨论了与碳交易有关的财务会计和报告问题，以及会计可能参与沟通气候风险和不确定性的方式。哈特曼等人。（2013）扩展这一讨论，并从管理会计的角度解释碳会计，以促进碳管理和控制的研究。这些早期的概念研究概述了后期碳核算研究的机遇和挑战。

In the rest of the section, we review the literature related to corporate carbon accounting. This literature is organised according to the following subject matter: financial accounting for carbon assets and liabilities, carbon disclosure, carbon assurance, carbon management, carbon performance, and the impact of carbon issues on the capital market. A list of the papers in each category is presented in Table 4.

3.1. Financial accounting for carbon assets and liabilities

The introduction of the carbon trading market raises a typical financial accounting question: how carbon allowances should be recorded in the books. The debate focuses on the valuation of allowances allocated for free and the volatility caused by different valuations of assets and recognition of liabilities (Bebbington and Larrinaga-González, 2008). The difficulty has to do mainly with the multiple implications of carbon allowances. Specifically, a carbon allowance acts as a permit for carbon emissions, a mandatory upper limit of carbon emissions and a financial asset that can be traded on the market. The conflict created by this unique feature of carbon allowances and the need for consistency between carbon-related assets/liabilities and other general assets/liabilities makes it difficult for standard setters to design a universal accounting standard (Cook, 2009).

Disagreement over accounting for carbon allowances led to the withdrawal of International Financial Reporting Interpretations Committee Interpretation 3: Emission Rights in June 2005. In the absence of accounting standards for emissions allowances, three different approaches are commonly used in practice: (i) a net liability approach that classifies allowances as intangible assets and only shows an emissions liability when emissions exceed free allocated allowances, (ii) a gross liability approach that recognises the free allocation at fair value and a corresponding gross liability, and (iii) an inventory approach with free allocations given at nil value (Black, 2013). A major concern around the discrepancies in accounting is that they can hinder the comparability of firms' financial statements (Warwick and Ng, 2012; Griffin, 2013) because firms have total discretion over the recognition and measurement of carbon allowances as either assets, liabilities or even expenses (Mete *et al.*, 2010). Therefore, scholars have called for a common approach to be adopted by accounting standard setters (Raibor and Massoud, 2010; Haupt and Ismer, 2013; Giner, 2014).⁵

⁵This issue is still on standard setters' agenda. In December 2012, the International Accounting Standards Board formally reactivated the project to consider the accounting treatment of carbon emission allowances awarded by a scheme administrator and liabilities associated with the emission of GHGs. In 2015, the project was re-scoped to consider a variety of schemes that use emissions allowances to manage the emission of pollutants. No further update after October 2015 can be found on the Board's website (see <https://www.iasplus.com/en/projects/research/short-term/emissions-trading>).

在本节的其余部分，我们将回顾与企业碳会计相关的文献。本文献是根据以下主题组织的：碳资产和负债的财务会计、碳披露、碳保证、碳管理、碳表现以及碳问题对资本市场的影响。表4列出了每个类别的论文清单。

3.1. 碳资产和负债的财务会计

碳交易市场的引入提出了一个典型的财务会计问题：碳津贴应该如何记录在账簿中。辩论的重点是免费分配的拨备的估值以及资产和负债确认的不同估值所造成的波动Bebbington and Larrinaga-González 2008。这一困难主要与碳排放量的多重影响有关。具体而言，碳津贴作为碳排放的许可证，碳排放的强制上限和可以在市场上交易的金融资产。碳津贴的这种独特特征以及碳相关资产负债与其他一般资产负债之间需要一致性所产生的冲突使得标准制定者难以设计通用会计准则Cook 2009。

关于碳津贴核算的分歧导致2005年6月撤回了国际财务报告解释委员会解释3：排放权。在没有排放限额会计标准的情况下，实践中通常使用三种不同的方法：(i)净负债方法，将限额归类为无形资产，只有在排放超过自由分配限额时才显示排放责任；(ii)确认以公允价值自由分配和相应的总负债的毛负债方法；(iii)以零值自由分配的清单方法(Black, 2013年)。会计差异的一个主要问题是，它们会阻碍公司财务报表的可比性(Warwick和Ng, 2012年；Griffin, 2013年)，因为公司对确认和衡量碳津贴作为资产、负债甚至费用有完全的自由裁量权(Mete等人)。2010).因此，学者们呼吁会计准则制定者采用共同的方法(Raibor和Massoud, 2010; Haupt和Ismer, 2013; Giner, 2014)。5

5这个问题仍在标准制定者的议程上。2012年12月，国际会计准则理事会正式启动了该项目，以考虑对计划管理人授予的碳排放津贴和与温室气体排放有关的负债的会计处理。在2015年，该项目被重新界定为考虑使用排放限额来管理污染物排放的各种计划。2015年10月之后没有进一步的更新可以在董事会的网站上找到(见<https://www.iasplus.com/en/projects/research/short-term/emissions-trading>)。

Table 4
Papers (117) by category (accounting journals, 2005–2018)

Category	Subcategory	Topic area	Papers
General discussions (4)			Asciu and Lovell (2011), Bebbington and Larrinaga-González (2008), Hartmann et al. (2013), Hopwood (2009)
Policy discussions (7)			Andrew and Cortese (2013), Boston and Lempp (2011), Callon (2009), Carter et al. (2011), Lodhia and Martin (2012a), Lodhia and Martin (2012b), McNicholas and Windsor (2011)
Specific corporate carbon issues			Black (2013), Cook (2009), Giner (2014), Griffin (2013), Haupt and Ismer (2013), Mete et al. (2010), Raibor and Massoud (2010), Ratnatunga et al. (2011), Warwick and Ng (2012)
Carbon disclosure (9)	Quality (11)		Andrew and Cortese (2011), Andrew et al. (2010), Comyns and Figge (2015), Cotter et al. (2011), Ferguson et al. (2016), Haigh and Shapiro (2012), Haque and Deegan (2010), Haslam et al. (2014), Kolk et al. (2008), Solomon et al. (2011), Stanny (2018)
Determinants (28)			Alraiz et al. (2016), Choi et al. (2013), Chu et al. (2013), Comyns (2018), Cowan and Deegan (2011), Datt et al. (2019a), de Aguiar and Bebbington (2014), Elsayih et al. (2018), Freedman and Jaggi (2005), Freedman and Park (2014), Freedman and Park (2017), Haque et al. (2016), Hollindale et al. (2019), Hrasky (2012), Liao et al. (2015), Liesen et al. (2015), Liu et al. (2017), Luo (2019), Luo et al. (2013), Luo and Tang (2014b), Luo and Tang (2016), Momin et al. (2017), Ott et al. (2017), Rankin et al. (2011), Tang and Luo (2016), Taurangana and Chithambo (2015), Yang and Farley (2016)

(continued)

Table 4
论文(17篇)(会计期刊2005-2018)

Category	Subcategory	范围	论文(17篇)(会计期刊2005-2018)	Papers
General discussions (4)			(2013), Hopwood (2009)	
Policy discussions (7)				
Specific corporate carbon issues				
Carbon disclosure (9)	Quality (11)			
Determinants (28)				

(continued)

Table 4 (continued)

Category	Subcategory	Topic area	Papers
Carbon assurance	(13)		Datt <i>et al.</i> (2018), Datt <i>et al.</i> (2019a), Green and Li (2012), Green and Taylor (2013), Green and Zhou (2013), Huggins <i>et al.</i> (2011), Kim <i>et al.</i> (2016), Martinov-Bennie (2012), Martinov-Bennie and Hoffman (2012), Olson (2010), Simnett <i>et al.</i> (2009), Tang (2019), Zhou <i>et al.</i> (2016)
Carbon management	Practices (11)		Bui and Fowler (2019), Burritt <i>et al.</i> (2011), Deegan and Islam (2012), Engels (2009), Gibassier and Schaltegger (2015), Ioannou <i>et al.</i> (2016), Lee and Wu (2014), Linnenluecke <i>et al.</i> (2015), Ratnatunga and Balachandran (2009), Tang and Luo (2014), Vesty <i>et al.</i> (2015)
	Determinants (11)		Bui and de Villiers (2017), Bui <i>et al.</i> (2020), Cadez and Guilding (2017), Herbohn <i>et al.</i> (2012), Jeffrey and Perkins (2014), Kumarasiri and Gunasekara (2017), Kumarasiri and Jubb (2016), Luo and Tang (2016a), Moore and McPhail (2016), Trotman and Trotman (2015), Yunus <i>et al.</i> (2016)
Carbon performance	Measurement (5)		Mackenzie (2009), Bowen and Wittneben (2011), Cooper and Pearce (2011), Mihe and Grubnic (2011), Young (2010)
	Determinants (6)		Birchall <i>et al.</i> (2015), Broadstock <i>et al.</i> (2018), Haque (2017), Hassan and Kouhy (2013), Jeffrey and Perkins (2015), Qian and Schaltegger (2017)
Impact on capital market (12)			Baboukardos (2017), Chapple <i>et al.</i> (2013), Clarkson <i>et al.</i> (2015), Cooper <i>et al.</i> (2018), Griffin and Lont (2018), Griffin and Sun (2013), Griffin <i>et al.</i> (2017), Johnston <i>et al.</i> (2008), Liesen <i>et al.</i> (2017), Luo and Tang (2014a), Matsumura <i>et al.</i> (2014), Saka and Oshika (2014)
Total (117)			

The top three contributing universities and authors: Western Sydney University, Qingliang Tang (14); University of Newcastle, Le Luo (13); University of New South Wales, Wendy Green (6).

Table 4 (continued)

Discussion of accounting for carbon allowances has faded out of accounting publications since 2014. However, the issue still exists and may become more significant when more and more countries around the world start to adopt ETSSs as means of controlling GHG emissions. Therefore, researchers can contribute to research on carbon financial accounting by further investigating this issue. Moreover, the treatment of carbon allowances is not the only issue in financial accounting related to climate change. Ratnatunga *et al.* (2011) propose their own model of accounting for various carbon-related items, such as emissions allowances (or rights), carbon sequestration and emissions control capabilities. Other items worthy of investigation include stranded assets and emissions control assets. We believe that further incorporation of carbon issues into accounting will be a fruitful avenue of research when the impact of climate change on the value of corporate assets becomes more significant.

3.2. Carbon disclosure

Corporations make disclosures around climate change through various channels. Some companies report GHG emissions to government agencies under certain regulatory schemes, others disclose climate change information in their annual reports or in stand-alone sustainability or corporate social responsibility (CSR) reports, and still others voluntarily make more detailed disclosures through the CDP (Huggins *et al.*, 2011). Of all carbon accounting issues, carbon disclosure is the most extensively studied (see Table 4). Studies on carbon disclosure can generally be divided into two categories. Studies in the first category are concerned with external and internal factors that affect firms' carbon disclosure decisions, and studies in the second evaluate and comment on the quality and adequacy of voluntary carbon disclosure.

3.2.1. Determinants and motivations of carbon disclosure

Research on the determinants of carbon disclosure helps researchers and policymakers understand how firms interpret and respond to pressures imposed by governments, communities and external groups, and may assist in establishing effective regulatory frameworks for promoting transparency in carbon control. A few theories on voluntary carbon disclosure, namely, legitimacy theory, stakeholder theory, signalling theory and institutional theory, are usually used as underlying theories in investigations of determinants and motivations of carbon disclosure. Although the theories take different perspectives, in general they suggest that a firm's propensity to disclose its true position regarding carbon emissions and carbon management is associated with social, market, economic, regulatory and institutional pressures when they are transferred into disclosure incentives. This relationship is illustrated in Figure 4, which is adapted from Luo *et al.* (2013).

自2014年以来，关于碳津贴核算的讨论已经淡出会计出版物。然而，当世界上越来越多的国家开始采用ETSSs作为控制温室气体排放的手段时，这个问题仍然存在，并且可能变得更加重要。因此，研究人员可以通过进一步调查这一问题，为碳财务会计的研究做出贡献。此外，碳津贴的处理并不是与气候变化有关的财务会计的唯一问题。Ratnatunga等人。(2011)提出自己的各种碳相关项目的核算模式，如排放许可（或权利），碳固存和排放控制能力。其他值得调查的项目包括搁浅资产和排放控制资产。我们相信，当气候变化对公司资产价值的影响变得更加显着时，进一步将碳问题纳入会计将是一个富有成效的研究途径。

3.2. 碳披露

企业通过各种渠道披露气候变化。一些公司根据某些监管计划向政府机构报告温室气体排放，其他公司在年度报告或独立的可持续性或企业社会责任（CSR）报告中披露气候变化信息，还有一些公司自愿通过CDP进行更详细的披露（Huggins等人）。2011).在所有碳核算问题中，碳披露是研究最广泛的（见表4）。关于碳披露的研究一般可分为两类。第一类研究涉及影响公司碳披露决策的外部和内部因素，第二类研究评估和评论自愿碳披露的质量和充分性。

3.2.1. 碳披露的决定因素和动机

对碳披露决定因素的研究有助于研究人员和政策制定者了解企业如何解释和应对政府、社区和外部团体施加的压力，并可能有助于建立有效的监管框架，以促进碳控制的透明度。一些关于自愿碳披露的理论，即合法性理论、利益相关者理论、信号理论和制度理论，通常被用作碳披露决定因素和动机调查的基础理论。虽然这些理论采取了不同的观点，但总体而言，它们表明，公司披露其在碳排放和碳管理方面的立场与社会、市场、经济、监管和制度压力有关，当这些压力被转移到披露激励措施中时。这种关系在图4中说明，其改编自Luo等人。(2013)。

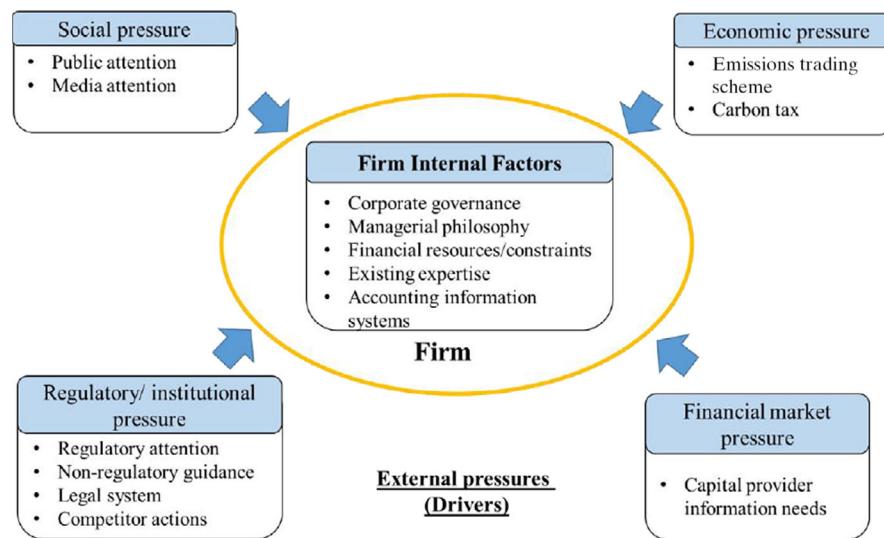


Figure 4 A framework of the determinants of corporate carbon disclosure, adapted from Luo *et al.* (2013). [Colour figure can be viewed at wileyonlinelibrary.com]

External pressures. Part of the literature considers how regulatory and institutional pressures affect firms' carbon disclosure. Researchers find that legal systems with strong protection of investors and stringent environmental regulations (such as common law systems) drive voluntary carbon disclosure (Luo *et al.*, 2012; Alrazi *et al.*, 2016; Tang and Luo, 2016). Another finding is that firms in carbon-intensive sectors tend to make more carbon disclosures than firms in other sectors because they face higher regulatory pressure (Rankin *et al.*, 2011; Choi *et al.*, 2013; Chu *et al.*, 2013; Tang and Luo, 2016). The positive influence of governmental or stock exchange regulations around carbon disclosure on the tendency to voluntarily disclose carbon information is confirmed by empirical studies set in Australia (Cowan and Deegan, 2011; Liu *et al.*, 2017), the United Kingdom (de Aguiar and Bebbington, 2014; Tauringana and Chithambo, 2015), the United States (Freedman and Park, 2014) and China (Yang and Farley, 2016). Furthermore, guidance from non-governmental institutions, such as the Global Reporting Initiative and CDP, can also positively influence the extensiveness and credibility of corporate carbon disclosure (Rankin *et al.*, 2011).

Some other studies consider the role of economic pressure in influencing carbon disclosure. One source of economic pressure is internalised carbon-related costs due to the implementation of climate policy (Bebbington and

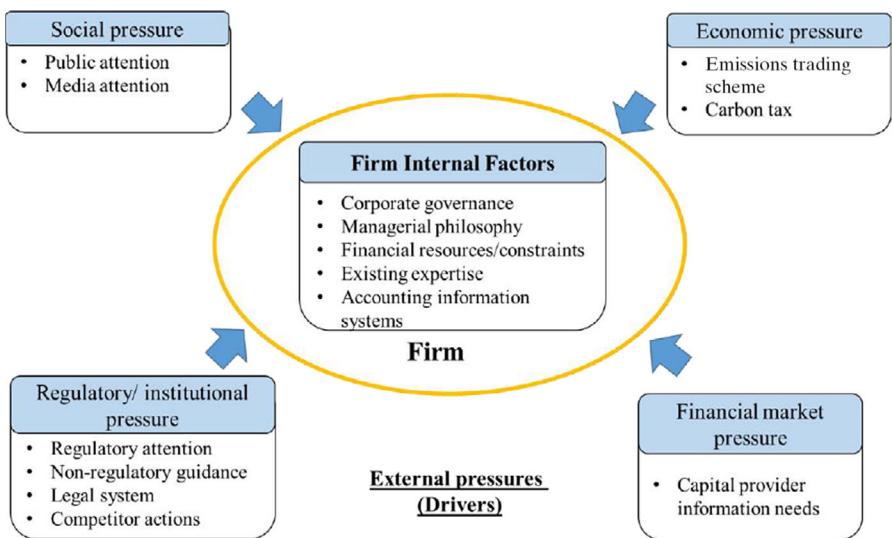


Figure 4 罗等人改编的公司碳披露决定因素的框架。(2013). [颜色图可于wileyonlinelibrary.com]

外部压力。部分文献考虑了监管和制度压力如何影响公司的碳披露。研究人员发现，保护投资者的法律制度和严格的环境法规（如普通法制度）推动了自愿碳披露（Luo *et al.*, 2012; Alrazi *et al.*, 2016; 唐和罗, 2016）。另一个发现是，碳密集型行业的公司往往比其他行业的公司披露更多的碳，因为它们面临更高的监管压力(Rankin *et al.*, 2011; Choi *et al.*, 2013; Chu *et al.*, 2013; 唐和罗, 2016)。澳大利亚的实证研究证实了政府或证券交易所关于碳披露的法规对自愿披露碳信息的趋势的积极影响(Cowan和Deegan, 2011; Liu *et al.*, 2017)，英国(de Aguiar和Bebbington, 2014; Tauringana和Chithambo, 2015)，美国(Freedman和Park, 2014)和中国(Yang和Farley, 2016)。此外，来自全球报告倡议组织和CDP等非政府机构的指导也可以对公司碳披露的广泛性和可信度产生积极影响(Rankin *et al.* 2011)。

其他一些研究考虑了经济压力在影响碳披露方面的作用。经济压力的一个来源是由于气候政策的实施而产生的内部碳相关成本(Bebbington 和

Larrinaga-González, 2008). Freedman and Jaggi (2005) show that firms with headquarters in countries that have ratified the Kyoto Protocol are more likely to provide detailed disclosures of their efforts and achievements when they are required to make large expenditures to meet the requirements of the Protocol.⁶ Another source of economic pressure is a firm's operating environment. Ott *et al.* (2017) argue that competition pressure may affect firms' decisions to voluntarily disclose carbon activity. They find that firms in more concentrated markets, in markets with more substitutability and in smaller markets are more likely to make their responses to the CDP survey publicly available because of increased pressure on firm operating efficiency and lower market entry barriers.

Other external pressures that have been considered in the literature include social pressures and financial market pressures. Research generally uses firm size as a proxy for social pressures, because it can be argued that larger firms attract greater attention from the media and regulators. In different settings, researchers confirm that social pressure is one driver of the likelihood and extent of voluntary carbon disclosure (Freedman and Jaggi, 2005; Luo *et al.*, 2012; Choi *et al.*, 2013; Chu *et al.*, 2013). Regarding financial market pressure, it is expected that investors play a crucial role in driving managers to disclose more information on GHG emissions in an effort to understand the exposure of their investment to climate risks and opportunities. However, empirical findings generally suggest no link or even a negative relationship between capital raising (Luo *et al.*, 2012; Tang and Luo, 2016) or ownership concentration (Liao *et al.*, 2015; Liesen *et al.*, 2015; Tauringana and Chithambo, 2015) and public carbon disclosure.

Firm characteristics. One firm characteristic that has been examined as a determinant of carbon disclosure is corporate governance structure. Two Australian studies, Rankin *et al.* (2011) and Choi *et al.* (2013), find a positive association between the overall quality of corporate governance and the propensity and extensiveness of carbon disclosure. Regarding specific board characteristics, Liao *et al.* (2015), Elsayih *et al.* (2018) and Hollindale *et al.* (2019) show that the percentage of female directors on the board is positively associated with the propensity to disclose carbon information. Liao *et al.* (2015) and Elsayih *et al.* (2018) further show that independent directors tend to favour more transparent carbon disclosure owing to their diverse backgrounds and lack of financial stake in the firm. Tauringana and Chithambo (2015) find that director ownership is negatively associated with a firm's carbon disclosure, which suggests that directors with higher ownership may resist undertaking carbon abatement activities, including disclosure, because of the uncertainty of

⁶Later studies cannot confirm their findings, possibly because the vast majority of countries have ratified the Protocol (see Luo *et al.*, 2012; Alrazi *et al.*, 2016; Tang and Luo, 2016).

Larrinaga-Gonzalez, 2008)。Freedman和Jaggi (2005)表明，总部设在已批准《京都议定书》的国家的公司更有可能在需要进行大量支出以满足《议定书》的要求时详细披露其努力和成就。经济压力的另一个来源是公司的经营环境。Ott等人。(2017)认为竞争压力可能会影响公司自愿披露碳活动的决定。他们发现，市场较集中、可替代性较强的市场和较小市场的公司更有可能公开其对CDP调查的答复，因为对公司经营效率的压力增加，市场进入壁垒降低。

文献中考虑过的其他外部压力包括社会压力和金融市场压力。研究通常使用公司规模作为社会压力的代理，因为可以说大公司吸引了媒体和监管机构的更多关注。在不同的环境中，研究人员确认社会压力是自愿碳披露的可能性和程度的一个驱动因素 (Freedman和Jaggi, 2005; Luo等。, 2012; Choi等人。, 2013; Chu等人。2013)。关于金融市场压力，预计投资者在推动管理人员披露更多关于温室气体排放的信息方面发挥关键作用，以努力了解其投资在气候风险和机会方面的然而，经验发现通常表明筹资之间没有联系，甚至没有负向关系 (罗等人。, 2012; Tang和Luo, 2016) 或所有权集中 (Liao等人。, 2015; Liesen等人。, 2015; Tauringana和Chithambo, 2015) 和公开碳披露。

坚定的特点。被视为碳披露决定因素的一个公司特征是公司治理结构。两项澳大利亚研究，Rankin等人。(2011) 和Choi等人。(2013年)，发现公司治理的整体质量与碳披露的倾向和广泛性之间存在积极的关联。关于特定的板特性，Liao等人。(2015)，Elsayih等人。(2018) 和Hollindale等人。

(2019年) 表明，女性董事在董事会中的比例与披露碳信息的倾向呈正相关。廖等人。(2015) 和Elsayih等人。(2018年) 进一步表明，独立董事倾向于更透明的碳披露，因为他们的背景不同，并且在公司中缺乏财务利益。Tauringana和Chithambo (2015) 发现，董事所有权与公司的碳披露呈负相关，这表明拥有更高所有权的董事可能会抵制进行碳减排活动，包括披露，因为

6后来的研究无法证实他们的发现可能是因为绝大多数国家已经批准了议定书见Luo et al., 2012; Alrazi等人。, 2016; 唐和罗, 2016)。

a payback on such a substantial environmental investment. Conversely, Elsayih *et al.* (2018) find a positive correlation between management ownership and carbon disclosure. They argue that enhanced management ownership may help align the interests of managers and shareholders; hence, managers would be more willing to communicate with shareholders with regard to climate change.

Other internal factors considered in the literature are financial characteristics, specifically, profitability, leverage and growth opportunities. Researchers generally expect a positive association between firm profitability and carbon disclosure (e.g., Freedman and Jaggi, 2005; Choi *et al.*, 2013; Chu *et al.*, 2013; Luo *et al.*, 2013; Ott *et al.*, 2017) based on the argument that higher profitability increases a firm's available financial resources and allows the firm to invest in carbon abatement and carbon disclosure. However, of all of the studies we review, only Ott *et al.* (2017) find a positive association between firms' decision to respond to the CDP survey and return on assets. All other studies fail to find significant effects of firm profitability on either the propensity or extent of carbon disclosure. Regarding the effects of leverage, it can be argued that higher leverage indicates more pressure, so management would be expected to disclose carbon information (Tang and Luo, 2016). However, a highly leveraged firm may prefer to withhold sensitive carbon risk information, fearing that heightened transparency could undermine its negotiating position (Luo and Tang, 2014b). The empirical results are inconclusive, with some studies finding a positive association (Tang and Luo, 2016), some a negative association (Luo and Tang, 2014b) and most no association (Freedman and Jaggi, 2005; Luo *et al.*, 2012; Luo and Tang, 2014b; Liesen *et al.*, 2015). In terms of firm growth opportunities, Luo *et al.* (2013) show that firms with high growth opportunities are less likely to make carbon disclosures, especially in less advanced economies. This finding indicates that when firms prioritise financial goals over environmental concerns, they divert fewer resources to carbon reduction and disclosure.

Still other factors that may affect a firm's decision to disclose carbon information include managers' attitudes and philosophies around environmental protection. Luo and Tang (2016b) examine the association between national culture and firms' responses to the CDP survey, given that culture can significantly influence managers' responses to carbon issues. They find that the cultural dimensions of masculinity, power distance, uncertainty avoidance, individualism and long-term orientation are significantly related to the propensity to disclose carbon information. Finally, the presence of an environmental management system in a firm is positively associated with the propensity to disclose as well as the credibility and extent of such disclosure, either because firms with an environmental management system are more likely to communicate their efforts for dealing with climate change to powerful

这是对如此巨大的环境投资的回报。相反，Elsayih等人。（2018）发现管理所有权和碳披露之间存在正相关关系。他们认为，加强管理所有权可能有助于调整管理者和股东的利益；因此，管理者将更愿意与股东就气候变化进行沟通。

文献中考虑的其他内部因素是财务特征istics，具体而言，盈利能力，杠杆和增长机会。研究通常预计公司盈利能力与碳披露之间存在正相关（例如，Freeman和Jaggi, 2005;Choi等人。, 2013;Chu等人。, 2013;罗等人。, 2013;Ott等人。 (2017年) 基于这样一个论点，即更高的盈利能力增加了公司的可用财务资源，并允许公司投资于碳减排和碳披露。然而，在我们审查的所有研究中，只有Ott等人。 (2017) 发现企业对CDP调查的回应决定与资产回报之间存在积极关联。所有其他研究都没有发现公司盈利能力对碳披露的倾向或程度的显着影响。关于杠杆的影响，可以认为更高的杠杆意味着更大的压力，因此管理层应该披露碳信息（唐和罗，2016）。然而，高杠杆公司可能更愿意保留敏感的碳风险信息，因为担心提高透明度可能会破坏其谈判立场（罗和唐，2014b）。实证结果尚无定论，一些研究发现积极关联（Tang和Luo, 2016），一些负面关联（Luo和Tang, 2014b），大多数没有关联（Freedman和Jaggi, 2005;Luo等。, 2012;罗和唐, 2014b;Liesen等。 2015）。在公司增长机会方面，罗等人。 (2013年) 表明，拥有高增长机会的公司不太可能披露碳排放，特别是在欠发达经济体。这

目标高于环境问题，它们将更多的资源转移到碳减排和披露上。

还有其他可能影响公司披露碳信息决定的因素包括管理人员对环境保护的态度和理念。罗和唐 (2016b) 研究了国家文化与企业对CDP调查的反应之间的关联，因为文化可以显着影响管理者对碳问题的反应。他们发现，男性气质，权力距离，不确定性避免，个人主义和长期取向的文化维度与披露碳信息的倾向显着相关。最后，公司中存在环境管理系统与披露的倾向以及这种披露的可信度和程度正相关，要么是因为拥有环境管理系统的公司更有可能将其应对气候变化的努力传达给强大的公司

stakeholders such as investors and the general public (Rankin *et al.* (2011) or because they have considerably lower additional preparation costs for public carbon disclosure (Ott *et al.* (2017).

3.2.2. The quality and adequacy of carbon disclosure

As corporate carbon disclosure remains voluntary in most of the world, several researchers express concerns about the quality of corporate carbon disclosure (e.g., Kolk *et al.*, 2008; Haque and Deegan, 2010; Stanny, 2018). More specifically, Cotter *et al.* (2011) find evidence that corporate disclosures tend to lack technical details and are somewhat skewed towards more positive aspects of climate change management. Comyns and Figge (2015) measure disclosure quality with a self-constructed index based on seven principles: accuracy, completeness, consistency, credibility, relevance, timeliness and transparency. They find that disclosure quality has not improved significantly and suggest that regulation is needed to discipline the practice. Haslam *et al.* (2014) criticise existing approaches that result in disclosures that 'generate malleable, inconsistent and irreconcilable numbers and narratives'. Haigh and Shapiro (2012) find that carbon emissions reports have some use in investors' assessments of firms' corporate governance but that the information on carbon performance may not affect investors' portfolio decisions. Solomon *et al.* (2011) explore the nature of one-on-one private meetings between institutional investors and their investee companies. The authors find that investors use the private reporting process to compensate for the acknowledged inadequacies of public climate change reporting.

The inadequacy of corporate carbon disclosure reflects the gap in expectations between stakeholders and corporate managers. While green communities and environmental regulators concern themselves with carbon pollution, managers focus primarily on compliance costs and risks and on financial performance for shareholders (Lodhia and Martin, 2012b; Haque *et al.*, 2016) and do not appear to be held accountable for the negative impact of operations on climate change (Haque *et al.*, 2016). Furthermore, methodological heterogeneity due to the voluntary nature of carbon disclosures may result in incomparable data and undermine the usefulness of such information; hence, mandatory regulation might be a solution (Andrew and Cortese, 2011). Generally speaking, concerns over the quality and reliability of voluntary carbon disclosure in the carbon accounting literature resonate with the critiques of early authors of sustainability accounting and disclosure (Hopwood, 2009; Gray, 2010). However, some authors point out that disclosure under the CDP system has improved (e.g., Luo and Tang, 2014b) and that carbon disclosure helps investors make decisions regarding firm market valuation (Matsumura *et al.*, 2014).

投资者和公众等利益相关者 (Rankin *et al.* (2011) , 或者因为他们有相当低的额外准备成本公开碳披露 (Ott等人。 (2017).

3.2.2. 碳披露的质量和充分性

由于公司碳披露在世界大部分地区仍然是自愿的，一些研究人员对公司碳披露的质量表示担忧 (例如, Kolktetal., 2008; Haque and Deegan, 2010; Stanny , 2018)。更具体地说, Cotter等人。 (2011) 发现证据表明, 公司披露往往缺乏技术细节, 并且在某种程度上偏向于气候变化管理的更积极方面。Comyns和Figge (2015) 根据七个原则用自建指数衡量披露质量: 准确性, 完整性, 一致性, 可信度, 相关性, 及时性和透明度。他们发现披露质量没有显著改善, 并建议需要监管来规范这种做法。Haslam等人。 (2014) 批评导致披露"产生可塑, 不一致和不可调和的数字和叙述"的现有方法。Haigh and Shapiro(2012)发现碳排放报告在投资者对公司公司治理的评估中有一些用处, 但碳绩效信息可能不会影响投资者的投资组合决策。所罗门等人。 (2011) 探索机构投资者与其被投资公司之间一对一私人会议的性质。作者发现, 投资者使用私人报告程序来弥补公共气候变化报告的公认不足。

公司碳披露的不足反映了利益相关者和公司经理之间的差距。虽然绿色社区和环境监管机构关注碳污染, 但管理者主要关注合规成本和风险以及股东的财务表现 (Lodhia and Martin, 2012b; Haqueetal., 2016年) , 并且似乎没有对行动对气候变化的负面影响负责 (哈克等人。 2016)。此外, 由于碳披露的自愿性质, 方法上的异质性可能导致无法比拟的数据并破坏这些信息的有用性;因此, 强制性监管可能是一种解决方案 (Andrew and Cortese, 2011)。一般来说, 对碳会计文献中自愿碳披露的质量和可靠性的担忧与可持续性会计和披露的早期作者的批评产生了共鸣 (Hopwood, 2009; Gray, 2010)。然而, 一些作者指出, CDP制度下的披露有所改善 (例如, Luo and Tang, 2014b) , 碳披露有助于投资者做出关于公司市场估值的决定 (Matsumuraetal. 2014)。

3.2.3. The relationship between carbon performance and carbon disclosure

Concerns over the quality of voluntary carbon disclosure raise the question of whether the carbon information voluntarily disclosed reflects a firm's underlying carbon performance, because there must be correspondence between the carbon disclosure and the firm's actual carbon performance for the disclosure to be useful. Two competing theories, signalling theory and legitimacy theory, are often proposed to explain the association between carbon performance and disclosure. Signalling theory suggests that adverse selection encourages good performers to make more credible, objective and quantitative disclosures so that they can distinguish themselves from poor performers (Spence, 1973; Verrecchia, 1983). Conversely, legitimacy theory suggests that the legitimacy threat motivates poor performers to disclose more (Gray *et al.*, 1995; Neu *et al.*, 1998; Aerts and Cormier, 2009).

Unfortunately, the empirical results for this research question are not conclusive. Luo and Tang (2014b) and Datt *et al.* (2019b) find support for signalling theory by showing that the extensiveness of carbon disclosure is positively associated with the firm's carbon mitigation performance. Ott *et al.* (2017) present similar but relatively weak evidence. In contrast, Momin *et al.* (2017), using data from China, find evidence consistent with legitimacy theory, whereas Alrazi *et al.* (2016) find no significant results. Luo (2019) offers another perspective by explaining that stringent carbon institutions can restrict firms' incentives to use carbon disclosure for legitimization attempts. Furthermore, Hrasky (2012) points out that whereas firms in carbon-intensive sectors reveal more behavioural information to signal their substantive action in coping with climate change, those in less carbon-intensive sectors rely more heavily on disclosing symbolic information. Ferguson *et al.* (2016) contend that the disclosures produced by participants in the UK ETS and Energy Efficiency Scheme not only were used to lend legitimacy to the organisations but also served to displace their own responsibility for addressing climate change and shift blame onto the government or suppliers as barriers to progress.

While firms' carbon performance may influence their disclosure behaviour, carbon disclosure impacts their carbon performance. Qian and Schaltegger (2017) argue that no matter whether firms make carbon disclosures for legitimacy or signalling purposes, carbon disclosure motivates companies and drives subsequent organisational change from the outside in. Their results show that change in carbon disclosure levels is positively associated with change in subsequent carbon performance.

3.2.4. Summary

Companies disclose carbon-related information through annual reports, sustainability or CSR reports, company websites and third-party channels such

3.2.3. 碳性能与碳披露的关系

对自愿碳披露质量的担忧提出了一个问题，即自愿披露的碳信息是否反映了公司的基本碳表现，因为碳披露和公司的实际碳表现之间必须有对应关系，才能使披露有用。两个相互竞争的理论，信号理论和合法性理论，经常被提出来解释碳性能和披露之间的关联。信号理论表明，不利的选择鼓励表现良好的人做出更可信，客观和数量的披露，以便他们能够将自己与表现不佳的人区分开来 (Spence, 1973; Verrecchia, 1983)。相反，合法性理论表明，合法性威胁促使表现不佳的人披露更多信息 (Grayetal., 1995; Neu等人。, 1998; Aerts和Cormier, 2009)。

不幸的是，这个研究问题的实证结果并不是决定性的。罗和唐 (2014b) 和Datt等人。 (2019b) 通过表明碳披露的广泛性与公司的碳减排绩效呈正相关，找到对信号理论的支持。Ott等人。 (2017) 提供类似但相对薄弱的证据。相比之下，Momin等人。 (2017)，使用来自中国的数据，找到符合合法性理论的证据，而Alrazi等人。 (2016) 没有发现显着结果。罗 (2019) 提供了另一个观点，解释说严格的碳排放机构可以限制公司利用碳披露进行合法化尝试的动机。此外，Hrasky(2012)指出，碳密集型行业的企业披露更多的行为信息以表明其应对气候变化的实质性行动，而碳密集型行业的企业更多地依赖于披露象征性信息。弗格森等人。 (2016) 认为，英国ETS和能源效率计划参与者所做的披露不仅被用来为组织提供合法性，而且还取代了他们自己应对气候变化的责任，并将责任转移到政府或供

虽然公司的碳绩效可能会影响其披露行为，但碳披露会影响其碳绩效。钱和沙尔特格 (Schaltegger, 2017年) 认为，无论公司是出于合法性还是信号目的进行碳披露，碳披露都会激励公司并推动随后的组织变革。他们的研究结果表明，碳披露水平的变化与后续碳性能的变化呈正相关。

3.2.4. Summary

公司通过年度报告、可持续发展或企业社会责任报告、公司网站和第三方渠道披露与碳相关的信息。

as the CDP survey. To date, carbon disclosure remains largely voluntary, and companies have discretion in whether, what and how much to disclose. The voluntary nature of carbon disclosure naturally stimulates two research questions. First, what factors affect firms' carbon disclosure decisions in terms of choice, content and extent? Second, how good are voluntary carbon disclosures? By reviewing the literature, we find that these two questions have received extensive examination.

In terms of the first question, the literature identifies a number of country-, sector- and firm-level factors related to firms' carbon disclosure decisions. We believe that this line of enquiry leaves much room for exploration. For example, although climate change mitigation is a highly political issue, prior studies have not considered politics as a country-level factor that may be associated with carbon disclosure. Researchers can also refer to our framework of determinants of carbon disclosure to identify other gaps in this area. The second question points out that voluntary carbon disclosure as it stands currently may be of low quality and inadequate. As suggested by Comyns and Figge (2015), disclosure quality is a multidimensional construct that includes accuracy, completeness, consistency, credibility, relevance, timeliness and transparency. The current literature focuses largely on the completeness and consistency of disclosures (Cotter *et al.*, 2011; Haslam *et al.*, 2014). Future research can look more closely at other dimensions of quality. A common issue related to disclosure quality is greenwashing (i.e., companies using voluntary environmental disclosure to portray themselves as ecologically friendly when they are not (Delmas and Burbano, 2011)). Thus, sustainability reporting could actually reduce what is known about a company and act as a corporate veil (Hopwood, 2009). Carbon accounting researchers can contribute to the literature by designing a systemic approach to detecting greenwashing and examining the causes and consequences of this practice. Furthermore, the research on carbon disclosure should certainly not stop at the two aforementioned research questions. Researchers can also explore the information needs of stakeholders to guide company practices and investigate the social and economic consequences of carbon disclosure.

3.3. Carbon assurance

The assurance of GHG statements is an emerging practice developed in response to evolving carbon regulations, which require accurate and reliable information on GHG emissions (Simnett *et al.*, 2009; Martinov-Bennie, 2012; Martinov-Bennie and Hoffman, 2012). Carbon assurance is different from traditional financial auditing in terms of the legal and regulatory environment, organisational participation, the materiality threshold, competencies required, accounting methods and users of the assurance reports (Olson, 2010). The current limited literature on carbon assurance focuses mainly on carbon assurance practices and determinants of firms' carbon assurance choices.

作为CDP调查。迄今为止，碳排放披露在很大程度上仍然是自愿的，公司可以自行决定是否披露，披露什么以及披露多少。碳披露的自愿性质自然激发了两个研究问题。首先，哪些因素会影响公司在选择、内容和程度方面的碳披露决策？其次，自愿碳披露有多好？通过查阅文献，我们发现这两个问题得到了广泛的考察。

就第一个问题而言，文献确定了与公司碳披露决策相关的一些国家，部门和公司层面的因素。我们认为，这条调查路线留下了很多探索空间。例如，尽管减缓气候变化是一个高度政治性的问题，但先前的研究并未将政治视为可能与碳披露相关的国家层面因素。研究人员还可以参考我们的碳披露决定因素框架，以确定该领域的其他差距。第二个问题指出，目前的自愿碳披露可能质量低且不充分。正如Comyns和Figge (2015) 所建议的那样，披露质量是一个多维结构，包括准确性，完整性，一致性，可信度，相关性，及时性和透明度。目前的文献主要关注公开的完整性和一致性 (Cotter *et al.*, 2011; Haslam等人, 2014)。未来的研究可以更密切地关注质量的其他方面。与披露质量相关的一个常见问题是绿化（即，公司使用自愿的环境披露来将自己描绘成生态友好的，当他们不这样做时 (Delmas和Burbano, 2011)）。因此，可持续发展报告实际上可以减少对公司的了解，并充当公司的面纱 (Hopwood, 2009)。碳核算研究人员可以通过设计一种系统的方法来检测绿色洗涤并检查这种做法的原因和后果来为文献做出贡献。此外，碳披露的研究当然不应停留在上述两个研究问题上。研究人员还可以探索利益相关者的信息需求，以指导公司实践并调查碳披露的社会和经济后果。

3.3. 碳保证

温室气体声明的保证是一种新兴的实践，是为了响应不断变化的碳法规而开发的，这些法规需要关于温室气体排放的准确可靠的信息(Simnett *et al.*, 2009; Martinov-Bennie, 2012; Martinov-Bennie and Hoffman, 2012)。碳保证在法律和监管环境，组织参与，重要性门槛，所需能力，会计方法和保证报告的用户方面与传统的财务审计不同 (Olson, 2010)。目前关于碳保证的有限文献主要集中在碳保证实践和公司碳保证选择的决定因素上。

Green and Zhou (2013) and Datt *et al.* (2018) provide detailed examinations of carbon assurance practices around the world. Their findings reflect the growth and evolving nature of this emerging market. Because carbon assurance requires not only auditing expertise but also specific subject matter expertise related to GHG emissions (Olson, 2010; Huggins *et al.*, 2011; Green and Taylor, 2013), two major types of carbon assurance provider exist: accounting firms and consulting firms. Although they perform the same task, they vary in terms of expertise required, skill and independence (Kim *et al.*, 2016). One popular topic in the assurance practice research is that of expectation gaps. Survey results from Green and Taylor (2013) and Green and Li (2012) indicate that expectation gaps exist among different groups of stakeholders in regard to the perceived quality of the assurance provider and the responsibilities of assurers and managers.

Current research on the determinants of voluntary carbon assurance considers the choice to engage and choice of assurance provider. Zhou *et al.* (2016) consider the influence of institutional background on firms' carbon assurance choices. They find that firms in stakeholder-oriented countries and countries with weaker legal enforcement are more likely to seek out carbon assurance. These factors also affect firms' choice of carbon assurance provider. Datt *et al.* (2019a) find that firms with a greater legitimacy threat are more likely to seek out carbon assurance, which indicates that external carbon assurance plays a role in enhancing the credibility of carbon disclosure and mitigating legitimacy threats. Datt *et al.* (2018) take a multi-theoretical perspective and find that carbon risks, carbon reduction initiatives, environmental committee, staff involvement in carbon actions and carbon disclosure scores are positively associated with a firm's propensity to obtain assurance. Furthermore, Tang (2019) shows that the creation of carbon institutions and significant increases in governmental green funding are the main drivers of the emergence and development of carbon auditing in a Chinese setting. He argues that carbon auditing has been used as a tool of social and economic reform in China for the promotion of sustainable sociotechnical and organisational innovation.

In sum, the literature considers incentives and determinants of the choice to seek out voluntary carbon assurance as well as the choice of assurance provider (Zhou *et al.*, 2016; Datt *et al.*, 2018, 2019a). Another focus is expectation gaps between users, assurers and companies regarding the purpose, responsibility and quality of carbon assurance (Green and Li, 2012; Green and Taylor, 2013). Despite the insights provided by the research, understanding of carbon assurance practices is still very limited. In particular, knowledge of the methodology of carbon assurance, including internal control, risk assessment and investigation, is absent from the current literature. Therefore, in-depth research on the methodology of carbon assurance is urgently needed. Furthermore, the research on current determinants focuses only on the choice to engage and the choice of provider; further research can investigate other choices, for example, the scale (scope 1, scope 2 or scope 3 emissions), level

Green和Zhou (2013) 和Datt等人。(2018)提供全球碳保证实践的详细检查。他们的研究结果反映了这个新兴市场的增长和不断变化的性质。因为碳保证不仅需要审计专业知识,还需要与温室气体排放相关的特定主题专业知识(Olson, 2010;Huggins等。, 2011;Green和Taylor, 2013),存在两种主要类型的碳保证提供商:会计师事务所和咨询公司。虽然他们执行相同的任务,但他们在所需的专业知识,技能和独立性方面有所不同(Kimetal 2016)。保证实践研究中的一个热门话题是期望差距。GreenAndTaylor(2013)和GreenAndLi(2012)的调查结果表明,不同利益相关者群体在验证提供者的感知质量以及验证师和管理人员的责任方面存在期望差距。

目前关于自愿碳保证决定因素的研究考虑了参与和选择保证提供者的选择。周等人。(2016) 考虑制度背景对公司碳保证选择的影响。他们发现,以利益相关者为导向的国家和执法力度较弱的国家的公司更有可能寻求碳保证。这些因素也会影响公司对碳保证提供商的选择。Datt等人。(2019a) 发现具有更大合法性威胁的公司更有可能寻求碳保证,这表明外部碳保证在提高碳披露的可信度和缓解合法性威胁方面发挥作用。Datt等人。(2018) 从多理论的角度来看,碳风险、碳减排倡议、环境委员会、员工参与碳行动和碳披露得分与公司获得保证的倾向呈正相关。此外, Tang (2019) 表明, 碳排放机构的建立和政府绿色资金的显着增加是中国碳审计出现和发展的主要驱动因素。他认为, 碳审计已被用作中国社会和经济改革的工具, 以促进可持续的社会技术和组织创新。

总之, 文献考虑了寻求自愿碳保证的激励和决定因素, 以及保证提供者的选择(Zhouetal, 2016;Datt等人。, 2018, 2019a)。另一个重点是用户, 咨询师和公司之间在碳保证的目的, 责任和质量方面的期望差距 (Green和Li, 2012;Green和Taylor, 2013)。尽管研究提供了见解, 但对碳保证实践的理解仍然非常有限。特别是, 目前的文献中没有关于碳保证方法的知识, 包括内部控制、风险评估和调查。因此, 迫切需要对碳保证的方法论进行深入研究。此外, 对当前决定因素的研究仅关注参与的选择和提供者的选择;进一步的研究可以调查其他选择, 例如, 规模 (范围1, 范围2或范围3排放), 水平

(percentage of carbon emissions assured), or type (limited, reasonable or high assurance) of assurance. Another promising area of future research is the quality of carbon assurance. Audit quality has always been a hot topic in the financial auditing literature (Watkins *et al.*, 2004; DeFond and Zhang, 2014). However, the literature is silent on the quality of carbon assurance.

3.4. Carbon management

A narrow definition of carbon management refers to the practices a company undertakes to mitigate its operational GHG emissions (Hartmann *et al.*, 2013). However, this concept can be extended to the management of all carbon-related issues of the company (Tang and Luo, 2014). In this section we review studies related to carbon management. Generally speaking, the literature on carbon management can be divided into two categories. The first category includes descriptive studies that report carbon management practices and organisational changes related to these practices, and the second includes studies that examine factors that affect firms' carbon management practices.

Firms use various carbon accounting techniques to help managers collect and record carbon-related information (Burritt *et al.*, 2011; Gibassier and Schaltegger, 2015), evaluate performance (Lee and Wu, 2014), perform green investment and project management (Vesty *et al.*, 2015), implement carbon strategies (Bui and Fowler, 2019), conduct emissions trading (Engels, 2009), manage exposure to risk (Kumarasiri and Gunasekara, 2017), control carbon costs (Ratnatunga and Balachandran, 2009) and assist in adapting to climate change (Linnenluecke *et al.* (2015)). Studies highlight the importance of embedding climate change information in carbon accounting practices. In addition, introducing carbon management accounting into an organisation may change the work and behaviour of actors and the way they react to authority and climate change (Vesty *et al.*, 2015). Furthermore, Tang and Luo (2014) propose a carbon management system that covers four broad components of carbon management: carbon governance, carbon operation, performance tracking and stakeholder engagement. A carbon management system is a functional tool used by a firm to implement its carbon policy, manage carbon risks and efficiently mitigate carbon emissions.

Regarding the factors that affect firm carbon management practices, prior studies show that carbon regulation/institution and regulatory uncertainty are closely related to firms' GHG control (Moore and McPhail, 2016). Specifically, Kumarasiri and Jubb (2016) find that regulations that impact companies' economic interests are likely to drive the use of carbon management accounting techniques such as target setting, performance measurement and incentives for emissions mitigation. Similarly, Bui *et al.* (2020) find that firms under regulatory pressure tend to use tight budgetary control in carbon management. Another driver of proactive carbon management strategies is a firm's carbon exposure (Jeffrey and Perkins, 2014; Luo and Tang, 2016a). For example,

(保证碳排放的百分比)，或类型（有限、合理或高度保证）的保证。未来研究的另一个有希望的领域是碳保证的质量。审计质量一直是财务审计文献中的热门话题(Watkins *et al.*, 2004; DeFond and Zhang, 2014)。然而，文献对碳保证的质量保持沉默。

3.4. 碳管理

碳管理的狭义定义是指公司为减少其运营温室气体排放而采取的措施(Hartmann *et al.* 2013)。然而，这个概念可以扩展到公司所有碳相关问题的管理 (Tang 和 Luo, 2014)。在本节中，我们将回顾与碳管理相关的研究。一般来说，关于碳管理的文献可分为两类。第一类包括描述性研究，报告碳管理实践和与这些实践相关的组织变化，第二类包括研究影响公司碳管理实践的因素的研究。

公司使用各种碳会计技术来帮助管理者收集和记录与碳有关的信息(Burrittetal., 2011;Gibassier和Schaltegger, 2015)，评估绩效 (Lee和Wu, 2014)，执行绿色投资和项目管理 (Vesty等。, 2015)，实施碳战略 (Bui和Fowler, 2019)，进行排放交易 (Engels, 2009)，管理风险暴露 (Kumarasiri 和Gunasekara, 2017)，控制碳成本 (Ratnatunga和Balachandran, 2009) 并协助适应气候变化 (Linnenluecke等。 (2015))。研究强调了将气候变化信息纳入碳核算实践的重要性。此外，将碳管理会计引入组织可能会改变行为者的工作和行为以及他们对权威和气候变化的反应方式(Vesty *et al.* 2015)。此外，唐和罗 (2014年) 提出了一个碳管理体系，涵盖了碳管理的四个广泛组成部分：碳治理、碳运营、绩效跟踪和利益相关者参与。碳管理系统是企业实施碳政策、管理碳风险和有效减少碳排放的实用工具。

关于影响公司碳管理实践的因素，先前的研究表明，碳监管机构和监管不确定性与公司的温室气体控制密切相关 (Moore和McPhail, 2016)。具体而言，Kumarasiri和Jubb(2016)发现影响公司经济利益的法规可能会推动碳管理会计技术的使用，例如目标设定，绩效衡量和减排激励。同样，Bui等人。(2020)发现处于监管压力下的公司倾向于在碳管理中使用严格的预算控制。积极主动的碳管理策略的另一个驱动因素是公司的碳暴露 (Jeffrey和Perkins, 2014;Luo和Tang, 2016a)。例如

managers' perceptions of climate change risks and opportunities motivate the use of carbon management accounting and reporting (Herbohn *et al.*, 2012; Trotman and Trotman, 2015). Other influential factors identified in the literature include reputational concerns and protection of economic interests (Trotman and Trotman, 2015; Kumarasiri and Gunasekara, 2017), carbon cost structures (Cadez and Guilding, 2017), management remuneration plans (Deegan and Islam (2012) and corporate governance structure (Yunus *et al.*, 2016).

The carbon management accounting literature enhances understanding of how accounting can help with carbon management. Many accounting concepts and approaches, such as reporting procedures, performance evaluation, risk assessment and target setting, are embedded in carbon management systems that enhance firms' capabilities for dealing with climate change (Tang and Luo, 2014). Researchers can make in-depth enquiries into each type of carbon management tool. An example of this type of research is Ioannou *et al.* (2016), who investigate the use of target setting in carbon management. They find that the difficulty of the carbon reduction target is positively associated with the percentage of target completion and that this effect is negatively moderated by the provision of monetary incentives.

We also suggest that carbon accounting researchers pay attention to carbon risk management. Although this topic is rarely addressed in accounting journals, some research on carbon risk has emerged in other business journals. Studies describe the carbon risks to which firms are exposed (Sakhel, 2017), factors that affect firm carbon risk management practices (Subramaniam *et al.*, 2015; Eljido-Ten and Clarkson, 2019), and the potential impact of carbon risk on firm capital financing (Jung *et al.*, 2018; Herbohn *et al.*, 2019) and decision-making (Haney, 2017).

Another area worthy of investigation is supply chain carbon management, which involves a comprehensive, cradle-to-grave analysis of the emissions of a product to achieve overall carbon mitigation or reduction. The carbon accounting literature remains silent on this topic. Future research may pay attention to operational issues related to the implementation of this approach. Potential research avenues include a determination of carbon emissions in the supply chain, an assessment of the carbon performance of each entity in the supply chain, and an investigation into uncertainty among supply chain partners around sharing sensitive proprietary information. Furthermore, accounting for carbon control in the supply chain goes beyond the scope of traditional financial accounting because it involves multiple reporting entities. Some enlightening accounting methods may need to be adopted to address the control of carbon emissions in the supply chain setting.

管理者对气候变化风险和机会的看法激励了碳管理会计和报告的使用(Herbohn *et al.*, 2012; Trotman and Trotman, 2015)。文献中确定的其他有影响力的因素包括声誉问题和经济利益保护 (Trotman and Trotman, 2015; Kumarasiri and Gunasekara, 2017)，碳成本结构 (Cadez and Guilding, 2017)，管理薪酬计划 (Deegan and Islam (2012) 和公司治理结构 (Yunus等。 2016).

碳管理会计文献增强了对会计如何帮助碳管理的理解。许多会计概念和方法，如报告程序、绩效评估、风险评估和目标设定，都嵌入到碳管理系统中，以提高企业应对气候变化的能力 (唐和罗, 2014年)。研究人员可以对每种类型的碳管理工具进行深入调查。这种类型的研究的一个例子是Ioannou等人。 (2016)，世卫组织调查碳管理中目标设定的使用。他们发现，碳减排目标的难度与目标完成的百分比呈正相关，而提供货币激励措施会对这种影响产生负面影响。

我们还建议碳会计研究人员关注碳风险管理。虽然会计期刊很少讨论这个主题，但其他商业期刊也出现了一些关于碳风险的研究。研究描述了公司所面临的碳风险 (Sakhel, 2017)，影响公司碳风险管理实践的因素 (Subramaniam等。, 2015; Eljido-Ten and Clarkson, 2019)，以及碳风险对公司资本融资的潜在影响 (Jung等。, 2018; Herbohn等人。, 2019) 和决策 (Haney, 2017) 。

另一个值得研究的领域是供应链碳管理，它涉及对产品的排放进行全面的，从摇篮到坟墓的分析，以实现整体碳减排或减少。碳会计文献对这个话题保持沉默。未来的研究可能会关注与实施这种方法相关的操作问题。潜在的研究途径包括确定供应链中的碳排放，评估供应链中每个实体的碳绩效，以及调查供应链合作伙伴之间围绕共享敏感专有信息的不确定性。此外，供应链中的碳控制会计超出了传统财务会计的范围，因为它涉及多个报告实体。可能需要采取一些有启发性的会计方法来解决供应链环境中碳排放的控制问题。

3.5. Carbon performance

Carbon performance generally refers to how well firms do at managing and controlling carbon emissions. The literature on carbon performance has two main focuses: the complexity of measuring carbon performance and the factors that affect firms' carbon performance.

The concept of carbon performance may be more complicated than it looks. First, measuring GHG emissions is a complex process and is based largely on estimation. The reliability and comparability of the results are questionable when different methods of estimating are used (MacKenzie, 2009). Second, researchers who measure emissions often encounter issues such as boundaries, scope and aggregate basis (Young, 2010; Bowen and Wittneben, 2011; Cooper and Pearce, 2011; Milne and Grubnic, 2011). Third, the term *carbon performance* can have different meanings depending on the purpose of the performance evaluation. It can be an absolute measure of GHG emissions, it can be an efficiency measure that equals GHG emissions per unit of production (such as gross domestic product or sales revenue), or it can reflect the change in the aforementioned measures across two time periods. Some studies also suggest that carbon abatement initiatives can be deemed process-based measures of carbon performance (Busch and Hoffmann, 2011; Haque, 2017). In empirical research, the first two concerns are generally ignored. As for the third, researchers use various measures of carbon performance depending on their research question. For example, Luo and Tang (2014b) suggest that the amount of absolute carbon emissions and carbon intensity are the most appropriate indicators, as the ultimate objective of carbon management is to reduce carbon emissions. Qian and Schaltegger (2017), in contrast, use the change in the intensity of direct and indirect carbon emissions as a measure of carbon performance.

With regard to factors that affect firm carbon performance, Tang and Luo (2014) demonstrate a significant impact of the overall quality of the carbon management system on the carbon performance of Australian firms. Jeffrey and Perkins (2015) show the positive effect of energy tax on reducing carbon intensity. Birchall *et al.* (2015) suggest that carbon accounting is not necessarily evidence of improvement in climate change abatement and that the voluntary carbon market is only moderately effective at decreasing emissions. Haque (2017) finds that certain corporate governance mechanisms are associated with process-based carbon performance (the undertaking of carbon mitigation initiatives) but not with outcome-based carbon performance (carbon emissions). Finally, Broadstock *et al.* (2018) demonstrate that carbon performance has a nonlinear relationship with firm financial performance, which indicates that the existence of a possible win-win situation is conditional.

Research on carbon performance shows that the complexity involved in measuring carbon performance may limit the reliability and comparability of carbon emissions reporting. Therefore, caution should be exercised when

3.5. 碳性能

碳绩效通常指企业在管理和控制碳排放方面的表现。关于碳绩效的文献主要有两个重点：衡量碳绩效的复杂性和影响公司碳绩效的因素。

碳性能的概念可能比看起来更复杂。首先，测量温室气体排放是一个复杂的过程，主要基于估算。当使用不同的估计方法时，结果的可靠性和可比性是值得怀疑的（MacKenzie, 2009）。其次，测量排放的研究人员经常遇到边界、范围和总体基础等问题（Young, 2010; Bowen 和 Wittneben, 2011; Cooper 和 Pearce, 2011; Milne 和 Grubnic, 2011）。第三，术语碳性能可以有不同的含义取决于性能评估的目的。它可以是温室气体排放量的绝对度量，可以是等于每单位生产（如国内生产总值或销售收入）温室气体排放量的效率度量，也可以反映上述度量在两个时一些研究还表明，碳减排举措可以被视为基于过程的碳绩效衡量标准（Busch 和 Hoffmann, 2011; Haque, 2017）。在实证研究中，前两个问题通常被忽略。至于第三种，研究人员根据他们的研究问题使用各种碳性能度量。例如，罗和唐（2014b）认为绝对碳排放量和碳强度是最合适的指标，因为碳管理的最终目标是减少碳排放。相比之下，Qian 和 Schaltegger（2017）使用直接和间接碳排放强度的变化作为碳绩效的衡量标准。

关于影响公司碳绩效的因素，Tang和Luo（2014）表明碳管理体系的整体质量对澳大利亚公司碳绩效的显着影响。Jeffrey和Perkins(2015)显示了能源税对降低碳强度的积极影响。Birchall等人。（2015年）表明，碳核算不一定是减缓气候变化改善的证据，自愿碳市场在减少排放方面只有适度有效。哈克（2017）发现，某些公司治理机制与基于过程的碳绩效（实施碳减排计划）有关，但与基于结果的碳绩效无关。最后，Broadstock等人。（2018）证明碳绩效与公司财务绩效具有非线性关系，这表明可能的双赢局面的存在是有条件的。

对碳绩效的研究表明，测量碳绩效所涉及的复杂性可能会限制碳排放报告的可靠性和可比性。因此，在以下情况下应谨慎行事

interpreting and using self-reported emissions data. Furthermore, our review shows that carbon performance as a research topic is still underexplored, although some studies have investigated the value relevance of carbon emissions, which we discuss next.

3.6. The impact of carbon issues on the capital market

Prior research examines investor reactions to GHG emissions and corporate efforts at carbon mitigation. It can be argued that carbon emissions diminish firm market value: the underlying rationale for this argument is that present and future compliance and carbon mitigation costs represent unbooked liabilities for firms. Studies that directly investigate the valuation effects of carbon emissions in the United Kingdom, the EU, the United States and Japan (Johnston *et al.*, 2008; Matsumura *et al.*, 2014; Saka and Oshika, 2014; Clarkson *et al.*, 2015; Baboukardos, 2017; Griffin *et al.*, 2017) provide consistent evidence in support of this argument. In addition, it appears that carbon disclosure might, to some degree, moderate the negative effects of carbon emissions on firm value (Griffin and Sun, 2013; Matsumura *et al.*, 2014; Saka and Oshika, 2014; Baboukardos, 2017; Liesen *et al.*, 2017).

Looking beyond the general valuation effects of carbon emissions, Clarkson *et al.* (2015) contend that not all emissions are relevant to valuation (i.e., only excessive emissions over allocated emissions allowances would be treated as potential liabilities by investors under an ETS). In addition, they find that firms' ability to pass on emissions costs to customers moderates the value-attenuating effects of carbon emissions. Their results suggest that the valuation effect of carbon emissions is a complex issue that is highly dependent on institutional factors such as carbon legislation, the efficiency of the financial market and legal mechanisms. In line with this argument, Baboukardos (2017) finds that the value reduction effects of carbon emissions were alleviated after the passage of the United Kingdom's mandatory carbon report regulation. Furthermore, Chapple *et al.* (2013) and Luo and Tang (2014a) use an event study methodology to find that firms in carbon-intensive sectors suffered a reduction in value upon the release of news that indicated an increased probability of carbon legislation (a carbon tax and ETS) passing in the Australian parliament. In addition, Griffin and Lont (2018) show that the Volkswagen emissions cheating scandal had a substantial and sustained negative effect on the security price of the firm and other large firms in the same industry. However, note that financial markets are inefficient at pricing publicly available information on carbon disclosure and performance because investors can achieve abnormal risk-adjusted returns when simply investing in portfolios constructed on the basis of GHG emissions disclosure and performance.

Overall, the value relevance of carbon emissions is related to the long-term debate over environmental performance and financial performance. Empirical

解释和使用自我报告的排放数据。此外，我们的综述表明，碳性能作为一个研究主题仍然被低估，尽管一些研究已经调查了碳排放的价值相关性，我们接下来讨论。

3.6. 碳问题对资本市场的影响

先前的研究考察了投资者对温室气体排放的反应和公司在碳减排方面的努力。可以说，碳排放降低了公司的市场价值：这一论点的根本理由是，目前和未来的合规性和碳减排成本代表了公司未挂钩的责任。直接调查英国，欧盟，美国和日本碳排放估值影响的研究（Johnston *et al.*, 2008; Matsumura 等人。, 2014; Saka 和 Oshika, 2014; Clarkson 等人。, 2015; Baboukardos, 2017; Griffin 等人。, 2017）提供一致的证据支持这一论点。此外，似乎碳披露可能在某种程度上缓和碳排放对公司价值的负面影响（Griffin 和 Sun, 2013; Matsumura 等人。, 2014; Saka 和 Oshika, 2014; Baboukardos, 2017; Liesen 等人。2017）。

超越碳排放的一般估值效应，Clarkson 等人。（2015年）认为并非所有排放都与估值相关（即只有超过分配排放限额的过量排放才会被投资者视为ETS下的潜在负债）。此外，他们发现公司将排放成本转嫁给客户的能力缓和了碳排放的价值衰减效应。他们的研究结果表明，碳排放的估值效应是一个复杂的问题，高度依赖于碳立法，金融市场效率和法律机制等制度因素。根据这一论点，Baboukardos(2017)发现，在英国强制性碳报告法规通过后，碳排放的价值减少效应得到了缓解。此外，Chapple 等人。（2013年）和罗和唐（2014a）使用事件研究方法发现，碳密集型行业的公司在发布表明碳立法（碳税和ETS）在澳大利亚议会通过的可能性增加的消息后，价值下降。此外，Griffin 和 Lont (2018) 表明，大众排放作弊丑闻对该公司和同行业其他大公司的证券价格产生了实质性和持续的负面影响。然而，请注意，金融市场在为公开可获得的碳披露和绩效信息定价方面效率低下，因为投资者只要投资于基于温室气体排放披露和绩效构建的投资组合，就能获得异常的风险调整后回报。

总体而言，碳排放的价值相关性与环境绩效和财务绩效的长期争论有关。实证研究

studies show a rather clear trend towards financial market participants becoming more and more sensitive to corporate GHG emissions and managers' response to climate change. The negative relationship between firm carbon emissions and firm value suggests that the market punishes firms for engaging in business as usual and rewards a proactive carbon strategy. These findings imply that firms must balance their goal of economic success with ecosystem stabilisation in an ever more carbon-restrained economy.

The research on capital markets in the carbon accounting literature has at least two limitations. First, current studies largely focus on outcome-based carbon performance (i.e., the level of carbon emissions), with little consideration of other carbon issues. Although this is understandable, because carbon emissions are probably the most readily available data related to firms' carbon management, attempts should be made to obtain other measures of firm carbon performance and test their impact on the capital market. Second, the current literature focuses exclusively on the equity market by considering the effects of firm carbon issues on firm value. Another important capital market – the debt market – is ignored. Although similar research attempts have been identified in other business journals, it is time for accounting scholars to seriously consider this issue. Thus, we suggest that researchers also examine the possible impact of carbon issues on firms' debt financing.

4. Discussion and avenues for future research

Carbon accounting research and practice emerged as an outcome of the Kyoto Protocol and the EU ETS. The increasing awareness of climate change in society and the adoption of accounting methods by organisations to address carbon issues appear to be the main drivers of the growth in carbon accounting research. Although carbon accounting was once treated as a component of CSR or environmental research, the growing literature suggests that it is gradually evolving into an independent research field. Carbon accounting contributes to the wider accounting literature by proposing and promoting new accounting practices, such as accounting for carbon assets and liabilities, carbon budgeting, carbon finance and carbon assurance. These emerging practices and their integration into traditional accounting systems demonstrate the increasingly important role of accounting in sustainable development. Furthermore, the literature shows that firms' carbon decisions are affected by a wide range of external and internal factors, including regulatory pressures, economic pressures, corporate governance and financial constraints. These studies not only make academic contributions in terms of theory building related to firms' carbon decision-making but also have practical implications for policymakers and regulators guiding firms in the transition to a low-carbon economy.

Despite the achievements of the current carbon accounting research, this field is still in the formative stage of development. Although we discuss possible

研究表明，金融市场参与者对公司温室气体排放和管理者对气候变化的反应越来越敏感的趋势相当明显。公司碳排放与公司价值之间的负面关系表明，市场惩罚公司照常经营，并奖励积极的碳战略。这些研究结果表明，在一个更加碳限制的经济中，企业必须在经济成功的目标与生态系统稳定之间取得平衡。

碳会计文献中对资本市场的研究至少有两个局限性。首先，目前的研究主要集中在基于结果的碳绩效（即碳排放水平）上，很少考虑其他碳问题。虽然这是可以理解的，因为碳排放可能是与公司碳管理有关的最容易获得的数据，应该尝试获得公司碳绩效的其他衡量标准，并测试它们对资本市场的影响。其次，目前的文献通过考虑公司碳问题对公司价值的影响，专门关注股票市场。另一个重要的资本市场 债务市场 被忽视。虽然在其他商业期刊中也发现了类似的研究尝试，但现在是会计学者认真考虑这个问题的时候了。因此，我们建议研究人员还研究碳问题对公司债务融资的可能影响。

4.未来研究的讨论和途径

碳核算研究和实践是

京都议定书和欧盟ETS。社会对气候变化的认识不断提高，组织采用会计方法解决碳问题似乎是碳会计研究增长的主要动力。虽然碳核算曾经被视为企业社会责任或环境研究的一个组成部分，但越来越多的文献表明它正在逐渐发展成为一个独立的研究领域。碳会计通过提出和推广新的会计实践，如碳资产和负债会计、碳预算、碳融资和碳保证，为更广泛的会计文献作出贡献。这些新出现的做法及其与传统会计制度的结合表明了会计在可持续发展方面日益重要的作用。此外，文献表明，公司的碳决策受到广泛的外部和内部因素的影响，包括监管压力，经济压力，公司治理和财务约束。这些研究不仅在与企业碳决策相关的理论建设方面做出了学术贡献，而且对指导企业向低碳经济转型的政策制定者和监管者具有实际意义。

尽管目前的碳核算研究取得了成就，但该领域仍处于形成发展阶段。虽然我们讨论可能

future research throughout the review, here we explore limitations of the current literature and opportunities for future research in more detail.

4.1. Application of theories and theorisation

One shortcoming of the current carbon accounting research is the lack of theorisation around corporate responses to climate change. Instead, the research focuses on applying theories to explain observed phenomena; thus, the main theoretical contribution is the testing of theories. Moreover, the application of theories is dominated by rather broad versions of stakeholder and legitimacy theories (Bebbington and Larrinaga, 2014; Deegan, 2014). Greater theoretical sophistication is needed so that existing practices in carbon accounting can be evaluated and critiqued and new and sounder practices developed (O'Dwyer and Unerman, 2016). Therefore, we suggest that carbon accounting researchers adopt new theoretical perspectives to provide nuanced insight into and broaden and deepen understanding of corporate carbon accounting issues.

4.2. Interactions among carbon accounting issues

The four carbon issues (disclosure, assurance, management and performance) discussed in this literature review do not exist independently of one another. Although there has been some discussion of the link between carbon performance and carbon disclosure (see Section 3.2.3), a link can also be seen between carbon management and carbon performance. For example, the use of target setting as a carbon management tool (Ioannou *et al.*, 2016) or the adoption of a good carbon management system (Tang and Luo, 2014) can have a positive impact on carbon performance. It could be argued that there are even more interactions among the four carbon accounting issues. For example, seeking out carbon assurance may motivate firms to improve their carbon measurement methods and therefore institute better carbon management systems. This may in turn improve carbon performance. To date there is limited evidence of interactions among different carbon accounting issues, and this provides opportunities for future research.

4.3. Research on developing countries

The vast majority of papers published in the carbon accounting literature focus on developed countries. We believe that investigating emerging economies may broaden the scope of the research. Not only do some developing countries (e.g., China, India and Russia) contribute significantly to global emissions, but they also may have distinctive political regimes, less developed financial markets and different managerial mindsets compared to developed countries. For example, opportunities exist in carbon accounting

未来的研究在整个评论中，我们在这里更详细地探讨了当前文献的局限性和未来研究的机会。

4.1.理论与理论的应用

目前碳核算研究的一个缺点是缺乏围绕企业应对气候变化的理论。相反，研究的重点是应用理论来解释观察到的现象；因此，主要的理论贡献是理论的测试。此外，理论的应用由相当广泛的利益相关者和合法性理论版本主导 (Bebbington and Larrinaga, 2014; Deegan, 2014)。需要更高的理论复杂性，以便对碳会计的现有实践进行评估和批评，并开发新的和更健全的实践 (O'Dwyer and Unerman, 2016)。因此，我们建议碳会计研究人员采用新的理论视角，为企业碳会计问题提供细致入微的见解，并拓宽和加深对企业碳会计问题的理解。

4.2.碳核算问题之间的相互作用

在这篇文献综述中讨论的四个碳问题（披露、保证、管理和绩效）并不是彼此独立存在的。虽然已经对碳绩效和碳披露之间的联系进行了一些讨论（见第3.2.3节），但也可以看到碳管理和碳绩效之间的联系。例如，使用目标设定作为碳管理工具 (Ioannou *et al.*, 2016) 或采用良好的碳管理系统 (Tang 和 Luo, 2014) 可以对碳绩效产生积极影响。可以说，四个碳核算问题之间存在更多的相互作用。例如，寻求碳保证可以激励公司改进其碳测量方法，从而建立更好的碳管理系统。这可能反过来改善碳性能。迄今为止，不同碳核算问题之间相互作用的证据有限，这为未来的研究提供了机会。

4.3.关于发展中国家的研究

碳核算文献中发表的绝大多数论文焦点调查新兴经济体可能会扩大研究范围。一些发展中国家(例如中国、印度和俄罗斯)不仅对全球排放量作出了重大贡献而且与发达国家相比它们也可能有独特的政治制度、不发达的金融市场和不同的管理思想。例如，碳核算存在机会

research in Chinese settings. The country established a national ETS in December 2017 that is expected to surpass the EU ETS to become the largest carbon trading market in the world. This will open the door to a new area of carbon accounting research and practice in the future. Moreover, comparing the results to findings obtained from developed countries can provide additional insights into practical and theoretical issues. Research with a focus on developing countries will complement the current research to provide a more balanced view of global climate change.

4.4. Internal carbon price mechanisms

Internal carbon pricing is becoming a powerful tool for driving reductions in emissions, incentivising low-carbon activities, encouraging innovation and ensuring sustained competitiveness (World Bank et al., 2017). In 2017, around 1,400 large companies were factoring an internal carbon price into their business plans, which represented an eight-fold increase from 2014 (CDP, 2017). Unlike external carbon prices, which are decided by governmental carbon policy (e.g., the carbon tax) or supply and demand (e.g., the carbon trading market), internal carbon prices are determined by organisations themselves. Research can greatly contribute to the academic literature and practice by investigating drivers of internal carbon pricing, methods used to determine internal carbon prices, and ways in which this practice can enhance firm carbon performance and efficiency.

4.5. Green investment and low-carbon initiatives

Green investment and low-carbon initiatives are the centre of a carbon strategy. These initiatives include energy-saving projects, the development of low-carbon products, the use of degradable materials and chemicals, the consumption of renewable energy, and other green projects that can offset carbon and promote energy efficiency. Currently there is a lack of study on the number, nature, scope and effectiveness of these initiatives. Research in this area can examine expenditures for mitigation, assess company commitment and evaluate the effectiveness and economic consequences of carbon abatement programmes.

4.6. Carbon accounting and new technology

Technological innovation, such as big data, artificial intelligence, Industry 4.0, cloud technology, digital data and machine learning, is penetrating traditional accounting information systems. However, current carbon accounting practices do not appear to be in step with the latest technological developments. Researchers may explore the potential of information technology for carbon accounting. For example, Tang and Tang (2019) propose a

中国环境的研究。该国于2017年12月建立了一个国家ETS，预计将超过欧盟ETS成为世界上最大的碳交易市场。这将为未来碳核算研究和实践的新领域打开大门。此外，将研究结果与发达国家的研究结果进行比较，可以为实际和理论问题提供更多的见解。以发展中国家为重点的研究将补充目前的研究，以提供更平衡的全球气候变化观点。

4.4. 内部碳价格机制

内部碳定价正在成为推动减排、激励低碳活动、鼓励创新和确保持续竞争力的有力工具（世界银行等）。2017年，在2017中，大约1400大公司将内部碳价格纳入其业务计划，这比2014增加了八倍（CDP, 2017）。与由政府碳政策（例如碳税）或供需（例如碳交易市场）决定的外部碳价格不同，内部碳价格由组织自己决定。通过调查内部碳定价的驱动因素，用于确定内部碳价格的方法以及这种做法可以提高公司碳绩效和效率的方式，研究可以大大有助于学术文献和实践。

4.5. 绿色投资和低碳倡议

绿色投资和低碳倡议是碳战略的核心。这些举措包括节能项目、开发低碳产品、使用可降解材料和化学品、消耗可再生能源以及其他可以抵消碳和促进能源效率的绿色项目。目前缺乏关于这些倡议的数量、性质、范围和效力的研究。这一领域的研究可以审查缓解支出，评估公司的承诺，并评估碳减排方案的有效性和经济后果。

4.6. 碳核算与新技术

大数据、人工智能、工业4.0、云技术、数字数据和机器学习等技术创新正在渗透传统会计信息系统。然而，目前的碳核算实践似乎与最新的技术发展并驾齐驱。研究人员可以探索信息技术在碳核算方面的潜力。例如，Tang and Tang (2019) 提出了一个

distributed carbon ledger for integrating carbon asset management and emissions trading based on blockchain technology. We expect that the application of blockchain and other new technology will be a promising area for future carbon accounting research.

5. Conclusion

Experts at the United Nations recently presented comprehensive and overwhelming evidence that the health of the ecosystem is deteriorating more rapidly than ever (United Nations, 2019). Given that climate change is taking on crisis proportions, our safety net is stretched almost to the breaking point,⁷ and the current global response is deemed to be insufficient, systematic transformative changes are urgently needed to restore and protect nature (United Nations, 2019). As the replacement of the Kyoto Protocol, the Paris Agreement sends a clear message of the need to decarbonise the economy and encourages businesses to adopt a long-term perspective that balances economy and ecology. In such a context, we perform a state-of-the-art survey of the carbon accounting research. Our findings suggest that carbon accounting did not exist as a field until the introduction of the first ETS in the EU in 2005. Now it is emerging as a distinct discipline and playing a more and more important role in the transition to a carbon-neutral society.

Despite the heterogeneity in the conceptualisation of carbon accounting, there is a consensus that corporate carbon accounting refers to the use of accounting methods to collect, analyse, verify and report climate change information, account for carbon assets and liabilities, manage carbon risks and evaluate carbon performance for more informed decision-making by managers and external users (Tang, 2017). Our analysis provides a comprehensive and up-to-date picture of historical trends, focal points and themes in the current carbon accounting literature. The study of carbon accounting is growing rapidly and steadily, in particular after the signing of the Paris Agreement, with a gradual shift from qualitative to empirical studies. Carbon accounting researchers are responsive to climate change and explore and identify various carbon accounting issues that are largely non-existent in, or ignored by, previous accounting research. As a result, carbon accounting is emerging as an independent field of study separate from general CSR or sustainability. Carbon accounting research identifies the patterns and determinants of managerial responses to climate change as well as the consequences of carbon emissions. It reveals the actions companies take and show how businesses are changing their policies in response to new carbon regulations and legislation, public and stakeholder sentiment, and other factors. It is well recognised that carbon

⁷UN News. UN climate reports a ‘red alert’ for the planet: Guterres, 26 February 2021. <https://news.un.org/en/story/2021/02/1085812>.

基于区块链技术的碳资产管理和排放交易集成的分布式碳分类账。我们预计区块链和其他新技术的应用将是未来碳核算研究的一个有希望的领域。

5. Conclusion

联合国的专家最近提出了全面和压倒性的证据，表明生态系统的健康状况比以往任何时候都更加迅速地恶化（联合国，2019）。鉴于气候变化正在呈现危机的比例，我们的安全网几乎延伸到临界点，⁷

目前的全球反应被认为是不够的，迫切需要系统的变革来恢复和保护自然（联合国，2019）。作为京都议定书的替代品，巴黎协定发出了一个明确的信息，即需要对经济进行脱碳，并鼓励企业采取平衡经济和生态的长期观点。在这样的背景下，我们对碳核算研究进行了最先进的调查。我们的研究表明，在2005年欧盟引入第一批ETS之前，碳核算并不是一个领域。现在，它正在成为一门独特的学科，在向碳中和社会的过渡中发挥着越来越重要的作用。

尽管碳核算的概念存在异质性，但人们一致认为，企业碳核算是指使用会计方法收集、分析、核实和报告气候变化信息、核算碳资产和负债、管理碳风险和评估碳绩效，以便管理者和外部用户做出更明智的决策（唐，2017年）。我们的分析提供了一个全面和最新的历史趋势，重点和主题在当前碳会计文献。碳核算的研究正在迅速而稳定地发展，特别是在《巴黎协定》签署后，从定性研究逐渐转向实证研究。碳会计研究人员对气候变化做出反应，并探索和识别各种碳会计问题，这些问题在以前的会计研究中基本上不存在或被忽视。因此，碳会计正在成为一个独立的研究领域，独立于一般的企业社会责任或可持续性。碳核算研究确定了管理层应对气候变化的模式和决定因素以及碳排放的后果。它揭示了公司采取的行动，并展示了企业如何根据新的碳法规和立法，公众和利益相关者的情绪以及其他因素改变政策。众所周知，碳

⁷联合国新闻.联合国气候报告地球“红色警报”：古特雷斯，26二月2021。https://news.un.org/en/story/2021/02/1085812。

accounting can play a key role in the journey through industry-sponsored decarbonisation programmes in the transition to a low-carbon planet.

However, we identify a few gaps in the current literature between the expectations of society and the current state of carbon accounting studies. For example, the current literature is largely descriptive but less constructive. These studies do not devise new technical accounting methods that accountants can adopt to improve carbon accounting practice, detect greenwashing, measure carbon performance, and so on. Furthermore, few novel approaches or unified hybrid accounting–climate schemes are proposed that can guide carbon accounting research and practice. Moreover, the current carbon accounting research is largely descriptive, with no new or innovative theoretical lens. It focuses overwhelmingly on developed nations at the expense of developing ones. Yet firms in some developing countries contribute huge GHG emissions. Moreover, the heavy focus on carbon disclosure is disproportionate to the more direct impacts of carbon management and carbon risk on ultimately achieving carbon reduction. The literature pays less attention to ecological outcomes, such as biodiversity, because it focuses too narrowly on firm value. In addition, there are measurement issues for carbon performance and carbon disclosure quality as well. The literature uncovers a contradiction between corporate carbon disclosure and underlying carbon performance, which resonates with the concern demonstrated in the CSR and sustainability literatures regarding managerial greenwashing. However, it does not provide an effective method for detecting this practice. These gaps between communities' expectations (explicit or implicit) and the status quo of current carbon studies suggest a lack of observable impact on carbon accounting practice. The intensified debate and discussion in the literature does not lead to the creation of formal carbon accounting standards or carbon disclosure guidelines. Moreover, there is a lack of knowledge and understanding of how new carbon assurance standards are implemented in practice, not to mention how these standards should be updated. Therefore, to develop possible generalisable principles for corporate carbon accounting systems, we issue an urgent call to strengthen the role of accounting in improving carbon management systems and strategies.

Carbon accounting research faces many challenges, and many areas of carbon accounting are not explored in the literature. Thus, we outline here the directions future researchers can consider in order to advance the study of carbon accounting. First, the research should provide powerful technical tools for carbon accounting, prioritise our research agenda and develop robust carbon accounting methods for decarbonisation. Novel carbon accounting tools and techniques will determine how tomorrow's organisations define, measure and report their impact on climate change. Second, future research may explore the interaction between carbon accounting and other business systems using a case study approach, which could draw on theoretical frameworks from prior studies (e.g., Laughlin, 1991; Burns and Scapens, 2000).

在向低碳星球过渡的过程中，会计可以通过行业赞助的脱碳计划发挥关键作用。

然而，我们在目前的文献中发现了社会期望与碳核算研究现状之间的一些差距。例如，目前的文献在很大程度上是描述性的，但缺乏建设性。这些研究没有设计出会计师可以采用的新技术会计方法来改善碳会计实践，检测greenwashing，衡量碳绩效等等。此外，很少有新的方法或统一的混合会计气候计划被提出来指导碳会计研究和实践。此外，目前的碳核算研究主要是描述性的，没有新的或创新的理论镜头。它主要侧重于发达国家，而牺牲了发展中国家。然而，一些发展中国家企业造成了巨大的温室气体排放。此外，对碳披露的高度关注与碳管理和碳风险对最终实现碳减排的更直接影响不成比例。文献较少关注生态结果，如生物多样性，因为它过于狭隘地关注企业价值。此外，碳性能和碳披露质量也存在测量问题。该文献揭示了企业碳披露与潜在碳绩效之间的矛盾，这与企业社会责任和可持续性文献中关于管理绿化的关注产生了共鸣。然而，它没有提供用于检测这种做法的有效方法。共同性预期（明确或隐含）与当前碳研究现状之间的这些差距表明，对碳核算实践缺乏可观察到的影响。文献中愈演愈烈的争论和讨论并没有导致正式的碳会计准则或碳披露准则的制定。此外，对新的碳保证标准在实践中如何实施缺乏知识和理解，更不用说这些标准应该如何更新了。因此，为制定企业碳会计制度可能的通用原则，我们发出紧急呼吁，加强会计在改善碳管理系统和战略方面的作用。

碳核算研究面临许多挑战，文献中没有探讨碳核算的许多领域。因此，我们在这里概述了未来研究人员可以考虑的方向，以推进碳核算的研究。首先，研究应该为碳核算提供强大的技术工具，优先考虑我们的研究议程，并为脱碳开发强大的碳核算方法。新的碳核算工具和技术将决定未来的组织如何定义、衡量和报告它们对气候变化的影响。其次，未来的研究可以使用案例研究方法探索碳核算与其他商业系统之间的相互作用，该方法可以借鉴先前研究的理论框架（例如，Laughlin, 1991; Burns and Scapens, 2000）。

The case study approach can illuminate how decarbonisation becomes infused into day-to-day business practice. Thus, we call for in-depth critical evaluation of carbon accounting practices to reveal the interplay and interactive dynamics of carbon accounting and overall business strategy (Bebbington and Larrinaga, 2014). Currently the knowledge remains speculative, under-specified and under-theorised. Carbon accounting is expected to play a proactive role in mobilising further complementary and reinforcing changes in the future. This reinforces our endeavour to bolster via research new organisational capacity and competencies that are structured, uniform and consolidated. To achieve this, accounting must hybridise with other disciplines to find appropriate solutions to these challenging problems. Finally, there is growing demand for carbon accounting and assurance personnel who possess knowledge of climate change and the skills of carbon accounting and assurance. To address the lack of skilled carbon accountants, it is critical that university business schools develop carbon accounting units and textbooks to educate a new generation of accountants.

In sum, we concur with Gray (2002), Hopwood (2009) and O'Dwyer and Unerman (2016) that further high-quality fieldwork is vital to advancing the study of accounting for decarbonisation, which has more or less been neglected (Bebbington and Thomson, 2013). Carbon accounting is expected to provide guidance to policymakers and corporations on best practices in decarbonisation. Accountants can help project carbon costs, prepare carbon budgets and reports, provide assurance and assist in effective carbon decision-making. The current carbon accounting research has provided many insights into the carbon mitigation issues that corporations are facing. It also sends a strong message to firms that, although carbon mitigation can be costly, firms should take early actions that will have a prolonged impact on operational structure, processes, efficiency, reputation and long-term sustainable outcomes within a carbon-constrained future. The current research findings enhance climate change awareness among corporate managers and provide suggestions for firms evaluating the costs and benefits of their climate change decisions. These findings are valuable for regulators and policymakers in terms of assisting in the design of climate policies and regulations.

References

- Aerts, W., and D. Cormier, 2009, Media legitimacy and corporate environmental communication, *Accounting, Organizations and Society* 34, 1–27.
 Alrazi, B., C. de Villiers, and C. J. Van Staden, 2016, The environmental disclosures of the electricity generation industry: a global perspective, *Accounting and Business Research* 46, 665–701.
 Andrew, J., and C. Cortese, 2011, Accounting for climate change and the self-regulation of carbon disclosures, *Accounting Forum* 35, 130–138.

案例研究方法可以阐明脱碳是如何融入日常业务实践的。因此，我们呼吁对碳会计实践进行深入的批判性评估，以揭示碳会计和整体业务战略的相互作用和互动动态 (Bebbington and Larrinaga, 2014)。目前这些知识仍然是投机性的没有明确的和理论性的。预计碳核算将在动员未来进一步补充和加强变革方面发挥积极作用。这加强了我们通过研究加强新的组织能力和能力的努力，这些能力和能力是结构化的，统一的和巩固的。为了实现这一目标，会计必须与其他学科混合，以找到适当的解决这些具有挑战性的问题的方法。最后，对拥有气候变化知识和碳核算和保证技能的碳核算和保证人员的需求不断增长。为了解决缺乏熟练的碳会计人员的问题，大学商学院必须开发碳会计单元和教科书来教育新一代会计师。

总之，我们同意Gray (2002)，Hopwood (2009) 和O'Dwyer和Unerman (2016) 认为，进一步高质量的实地工作对于推进脱碳会计研究至关重要，这或多或少被忽视了 (Bebbington and Thomson, 2013)。碳核算有望为政策制定者和企业提供关于脱碳的最佳实践的指导。会计师可以帮助项目碳成本，准备碳预算和报告，提供保证和协助有效的碳决策。目前的碳核算研究为企业面临的碳减排问题提供了许多见解。它还向企业发出了一个强烈的信息，即尽管碳减排可能代价高昂，但企业应该尽早采取行动，在碳限制的未来，对运营结构、流程、效率、声誉和长期可持续结果产生长期影响。目前的研究结果提高了企业管理者对气候变化的认识，并为企业评估其气候变化决策的成本和收益提供了建议。这些发现对于监管机构和政策制定者在协助设计气候政策和法规方面很有价值。

References

- Aerts, W.和D.Cormier, 2009, 媒体合法性和企业环境传播, 会计, 组织和社会34, 1–27。Alrazi, B., c.deVilliers和C.J.VanStaden, 2016, theenvironmentaldisclosures oftheelectricitygenerationindustry: aglobalperspective, AccountingandBusinessResearch46, 665–701。
 Andrew, J.和C.Cortese, 2011, 会计气候变化和碳披露的自我监管, 会计论坛35, 130–138。

- Andrew, J., and C. Cortese, 2013, Free market environmentalism and the neoliberal project: the case of the Climate Disclosure Standards Board, *Critical Perspectives on Accounting* 24, 397–409.
- Andrew, J., M. A. Kaidonis, and B. Andrew, 2010, Carbon tax: challenging neoliberal solutions to climate change, *Critical Perspectives on Accounting* 21, 611–618.
- Ascui, F., 2014, A review of carbon accounting in the social and environmental accounting literature: what can it contribute to the debate?, *Social and Environmental Accountability Journal* 34, 6–28.
- Ascui, F., and H. Lovell, 2011, As frames collide: making sense of carbon accounting, *Accounting, Auditing and Accountability Journal* 24, 978–999.
- Baboukardos, D., 2017, Market valuation of greenhouse gas emissions under a mandatory reporting regime: evidence from the UK, *Accounting Forum* 41, 221–233.
- Bebbington, J., and C. Larrinaga, 2014, Accounting and sustainable development: an exploration, *Accounting, Organizations and Society* 39, 395–413.
- Bebbington, J., and C. Larrinaga-González, 2008, Carbon trading: accounting and reporting issues, *European Accounting Review* 17, 697–717.
- Bebbington, J., and I. Thomson, 2013, Sustainable development, management and accounting: boundary crossing, *Management Accounting Research* 24, 277–283.
- Birchall, S. J., M. Murphy, and M. J. Milne, 2015, Evolution of the New Zealand voluntary carbon market: an analysis of CarboNZero client disclosures, *Social and Environmental Accountability Journal* 35, 142–156.
- Black, C. M., 2013, Accounting for carbon emission allowances in the European Union: in search of consistency, *Accounting in Europe* 10, 223–239.
- Borhei, Z., 2021, Carbon disclosure: a systematic literature review, *Accounting and Finance*, <https://doi.org/10.1111/acfi.12757>
- Boston, J., and F. Lempp, 2011, Climate change: explaining and solving the mismatch between scientific urgency and political inertia, *Accounting, Auditing and Accountability Journal* 24, 1000–1021.
- Bowen, F., and B. Wittneben, 2011, Carbon accounting: negotiating accuracy, consistency and certainty across organisational fields, *Accounting, Auditing and Accountability Journal* 24, 1022–1036.
- Broadstock, D. C., A. Collins, L. C. Hunt, and K. Vergos, 2018, Voluntary disclosure, greenhouse gas emissions and business performance: assessing the first decade of reporting, *British Accounting Review* 50, 48–59.
- Bui, B., and C. de Villiers, 2017, Business strategies and management accounting in response to climate change risk exposure and regulatory uncertainty, *The British Accounting Review* 49, 4–24.
- Bui, B., and C. J. Fowler, 2019, Strategic responses to changing climate change policies: the role played by carbon accounting, *Australian Accounting Review* 29, 360–375.
- Bui, B., L. Chapple, and T. P. Truong, 2020, Drivers of tight carbon control in the context of climate change regulation, *Accounting and Finance* 60, 183–226.
- Burns, J., and R. W. Scapens, 2000, Conceptualizing management accounting change: an institutional framework, *Management Accounting Research* 11, 3–25.
- Burritt, R. L., S. Schaltegger, and D. Zvezdov, 2011, Carbon management accounting: explaining practice in leading German companies, *Australian Accounting Review* 21, 80–98.
- Busch, T., and V. H. Hoffmann, 2011, How hot is your bottom line? Linking carbon and financial performance, *Business and Society* 50, 233–265.
- Cadez, S., and C. Guilding, 2017, Examining distinct carbon cost structures and climate change abatement strategies in CO₂ polluting firms, *Accounting, Auditing and Accountability Journal* 30, 1041–1064.

- Callon, M., 2009, Civilizing markets: carbon trading between in vitro and in vivo experiments, *Accounting, Organizations and Society* 34, 535–548.
- Carter, C., S. Clegg, and N. Wählín, 2011, When science meets strategic realpolitik: the case of the Copenhagen UN climate change summit, *Critical Perspectives on Accounting* 22, 682–697.
- CDP, 2017, *Putting a price on carbon: integrating climate risk into business planning*. Available at: <https://b8f65cb373b1b7b15feb-c70d8ead6ced550b4d987d7c03fcdd1d.ssl.cf3.rackcdn.com/cms/reports/documents/000/002/738/original/Putting-a-price-on-carbon-CDP-Report-2017.pdf?1508947761>
- Chapple, L., P. M. Clarkson, and D. L. Gold, 2013, The cost of carbon: capital market effects of the proposed Emission Trading Scheme (ETS), *Abacus* 49, 1–33.
- Choi, B. B., D. Lee, and J. Psaros, 2013, An analysis of Australian company carbon emission disclosures, *Pacific Accounting Review* 25, 58–79.
- Chu, C. I., B. Chatterjee, and A. Brown, 2013, The current status of greenhouse gas reporting by Chinese companies: a test of legitimacy theory, *Managerial Auditing Journal* 28, 114–139.
- Clarkson, P. M., Y. Li, M. Pinnuck, and G. D. Richardson, 2015, The valuation relevance of greenhouse gas emissions under the European Union Carbon Emissions Trading Scheme, *European Accounting Review* 24, 551–580.
- Comyns, B., 2018, Climate change reporting and multinational companies: insights from institutional theory and international business, *Accounting Forum* 42, 65–77.
- Comyns, B., and F. Figge, 2015, Greenhouse gas reporting quality in the oil and gas industry: a longitudinal study using the typology of 'search', 'experience' and 'credence' information, *Accounting, Auditing and Accountability Journal* 28, 403–433.
- Cook, A., 2009, Emission rights: from costless activity to market operations, *Accounting, Organizations and Society* 34, 456–468.
- Cooper, S., and G. Pearce, 2011, Climate change performance measurement, control and accountability in English local authority areas, *Accounting, Auditing and Accountability Journal* 24, 1097–1118.
- Cooper, S. A., K. K. Raman, and J. Yin, 2018, Halo effect or fallen angel effect? Firm value consequences of greenhouse gas emissions and reputation for corporate social responsibility, *Journal of Accounting and Public Policy* 37, 226–240.
- Cotter, J., M. Najah, and S. S. Wang, 2011, Standardized reporting of climate change information in Australia, *Sustainability Accounting, Management and Policy Journal* 2, 294–321.
- Cowan, S., and C. Deegan, 2011, Corporate disclosure reactions to Australia's first national emission reporting scheme, *Accounting and Finance* 51, 409–436.
- Datt, R., L. Luo, Q. Tang, and G. Mallik, 2018, An international study of determinants of voluntary carbon assurance, *Journal of International Accounting Research* 17, 1–20.
- Datt, R. R., L. Luo, and Q. Tang, 2019a, The impact of legitimacy threat on the choice of external carbon assurance: evidence from the United States, *Accounting Research Journal* 32, 181–202.
- Datt, R. R., L. Luo, and Q. Tang, 2019b, Corporate voluntary carbon disclosure strategy and carbon performance in the USA, *Accounting Research Journal* 32, 417–435.
- de Aguiar, T. R. S., and J. Bebbington, 2014, Disclosure on climate change: analysing the UK ETS effects, *Accounting Forum* 38, 227–240.
- Deegan, C., 2014, An overview of legitimacy theory as applied within the social and environmental accounting literature, in: J. Bebbington, J. Unerman, and B. O'Dwyer, eds., *Sustainability Accounting and Accountability*, 2nd edn (Routledge, London), 248–272.

Callon M. 2009 Civilizingmarkets:carbontradingbetweeninvitroandinvivoexperiments Accounting OrganizationsandSociety34 535–548.Carter C. S.Clegg AndN.w.ahlin 201 1 Whenscience meetsstrategicrealpolitik:ThethecaseOfTheCopenhagenUNclimatechang esummit CriticalPerspectivesonAccounting22 682–697.

CDP, 2017, 为碳定价: 将气候风险纳入业务规划。在: <https://b8f65cb373b1b7b15feb-c70d8ead6ced550b4d987d7c03fcdd1d.sslcf3.rackcdn.comcms报告文件000002738原始Putting-a-price-oncarbon-CDP-Report-2017.pdf?1508947761>Chapple, L., P.M.Clarkson and D.L.Gold, 2013, 碳成本: 拟议排放交易计划 (ETS) 的资本市场效应, *Abacus* 49, 1–33。Choi, B.B., D.Lee and J.Psaros, 2013, 澳大利亚公司碳排放披露分析, *太平洋会计评论* 25, 58–79。Chu C I.B.Chatterjee AndA.Brown 2013 ThecurrentstatusofgreenhousegasreportingbyChinesecompanies:atestoflegitimacytheory *ManagementAuditingJournal* 28 114 139.

Clarkson P.M. Y.Li M.Pinnuck AndG.D.Richardson 2015 thevaluationrelevanceofgreenhousegasemissionsunderTheEuropeanUnionCarbonEmissionsTradingScheme *EuropeanAccountingReview* 24 551–580.

Comyns B. 2018 气候变化报告和跨国公司: 从制度理论和国际商业的见解 *会计论坛* 42 65–77.Comyns, B. 和 F. Figge, 2015, 石油和天然气行业的温室气体报告质量: 使用"搜索", "经验"和"信誉"信息类型学的纵向研究, *会计, 审计和问责期刊* 28, 403–433。Cook, A., 2009, 排放权: 从无成本活动到市场运营, *会计, 组织和社会* 34, 456–468。

Cooper, S. 和 G. Pearce, 2011, 气候变化绩效测量, 控制和问责制在英国地方当局领域, *会计, 审计和问责期刊* 24, 1097–1118。

Cooper, S.A., K.K.Raman和J.Yin, 2018, 光环效应还是堕落天使效应? 温室气体排放的公司价值后果和企业社会责任的声誉, *会计与公共政策杂志* 37, 226–240。Cotter, J., M.Najah and S.S.Wang, 2011, 澳大利亚气候变化信息标准化报告, 可持续性会计, 管理和政策杂志 2, 294–321。Cowan, S. 和 C.Deegan, 2011, 企业披露对澳大利亚第一个国家排放报告计划的反应, *会计和财务* 51, 409–436。Datt, R., L.Luo, Q. Tang 和 G.Mallik, 2018, 自愿碳保证决定因素的国际研究, *国际会计研究杂志* 17, 1–20。Datt, R.R., L.Luo 和 Q.Tang, 2019a, 合法性威胁对外部碳保证选择的影响: 来自美国的证据, *会计研究期刊* 32, 181–202。

Datt R.R. L.Luo 和 Q.Tang 2019B 美国企业自愿碳披露策略和碳绩效 *会计研究杂志* 32 417–435.deAguiar, T.R.S. 和 J.Bebbington, 2014, 气候变化披露: 分析英国ETS影响, *会计论坛* 38, 227–240。Deegan, C., 2014, 社会和环境会计文献中应用的合法性理论概述, 载于: J.Bebbington, J.Unerman 和 B.O'Dwyer, eds., 可持续性会计和问责制, 第二edn (Routledge, 伦敦), 248–272。

- Deegan, C., and M. A. Islam, 2012, Corporate commitment to sustainability – is it all hot air? An Australian review of the linkage between executive pay and sustainable performance, *Australian Accounting Review* 22, 384–397.

DeFond, M., and J. Zhang, 2014, A review of archival auditing research, *Journal of Accounting and Economics* 58, 275–326.

Delmas, M. A., and V. C. Burbano, 2011, The drivers of greenwashing, *California Management Review* 54, 64–87.

Elijido-Ten, E. O., and P. Clarkson, 2019, Going beyond climate change risk management: insights from the world's largest most sustainable corporations, *Journal of Business Ethics* 157, 1067–1089.

Elsayih, J., Q. Tang, and Y.-C. Lan, 2018, Corporate governance and carbon transparency: Australian experience, *Accounting Research Journal* 31, 405–422.

Engels, A., 2009, The European Emissions Trading Scheme: an exploratory study of how companies learn to account for carbon, *Accounting, Organizations and Society* 34, 488–498.

Ferguson, J., T. R. Sales de Aguiar, and A. Fearfull, 2016, Corporate response to climate change: language, power and symbolic construction, *Accounting, Auditing and Accountability Journal* 29, 278–304.

Freedman, M., and B. Jaggi, 2005, Global warming, commitment to the Kyoto protocol, and accounting disclosures by the largest global public firms from polluting industries, *The International Journal of Accounting* 40, 215–232.

Freedman, M., and J. D. Park, 2014, Mandated climate change disclosures by firms participating in the regional greenhouse gas initiative, *Social and Environmental Accountability Journal* 34, 29–44.

Freedman, M., and J. Park, 2017, SEC's 2010 release on climate change: shifting from voluntary to mandatory climate change disclosure, *Social and Environmental Accountability Journal* 37, 203–221.

Gibassier, D., and S. Schaltegger, 2015, Carbon management accounting and reporting in practice: a case study on converging emergent approaches, *Sustainability Accounting, Management and Policy Journal* 6, 340–365.

Giner, B., 2014, Accounting for emission trading schemes: a still open debate, *Social and Environmental Accountability Journal* 34, 45–51.

Gray, R., 2002, Of messiness, systems and sustainability: towards a more social and environmental finance and accounting, *The British Accounting Review* 34, 357–386.

Gray, R., 2010, Is accounting for sustainability actually accounting for sustainability ... and how would we know? An exploration of narratives of organisations and the planet, *Accounting, Organizations and Society* 35, 47–62.

Gray, R., R. Kouhy, and S. Lavers, 1995, Corporate social and environmental reporting: a review of the literature and a longitudinal study of UK disclosure, *Accounting, Auditing and Accountability Journal* 8, 47–77.

Green, W., and Q. Li, 2012, Evidence of an expectation gap for greenhouse gas emissions assurance, *Accounting, Auditing and Accountability Journal* 25, 146–173.

Green, W., and S. Taylor, 2013, Factors that influence perceptions of greenhouse gas assurance provider quality, *International Journal of Auditing* 17, 288–307.

Green, W., and S. Zhou, 2013, An international examination of assurance practices on carbon emissions disclosures, *Australian Accounting Review* 23, 54–66.

Griffin, P. A., 2013, Cap-and-trade emission allowances and US companies' balance sheets, *Sustainability Accounting, Management and Policy Journal* 4, 7–31.

Griffin, P. A., and D. H. Lont, 2018, Game changer? The impact of the VW emission-cheating scandal on the interrelation between large automakers' equity and credit markets, *Journal of Contemporary Accounting and Economics* 14, 179–196.

- Deegan, C.和M.A.Islam, 2012, 企业对可持续性的承诺-这都是热空气吗? AAn Australi an review of the linkage between executive pay and sustainable performance Australian Accounting Review 22 384-397. DeFond M. And J. Zhang 2014 a review of archival auditing research Journal Of Accounting and Economics 58 275-326.

Delmas, M.A.和V.C.Burbano, 2011, greenwashing的驱动程序, 加利福尼亚州管理评论 54, 6 4-87。

Elijido-Ten, E.O.和P.Clarkson, 2019, 超越气候变化风险管理: 世界上最大的最可持续公司的见解, 商业道德杂志 157, 1067-1089. Elsayih J. Q. Tang And Y.-C. Lan 2018 公司治理和碳透明度: 澳大利亚经验 会计研究杂志 31 405-422. 恩格斯, A., 2009, 欧洲排放交易计划: 公司如何学习核算碳, 会计, 组织和社会的探索性研究 34, 488-498. Ferguson, J., T.R.SalesdeAguiar 和 A.Fearfull, 2016, 企业应对气候变化: 语言, 权力和符号建设, 会计, 审计和问责期刊 29, 278-304。

Freedman M. And B.Jaggi 2005 Global warming commitment to The Kyoto protocol and accounting disclosures by the largest global public firms from polluting industries The International Journal of Accounting 40 215-232. Freedman, M. 和 J.D.Park, 2014, 授权参与区域温室气体倡议的公司披露气候变化, 社会和环境责任杂志 34, 29-44。

Freedman, M. 和 J.Park, 2017, SEC的2010年发布气候变化: 从自愿转变为强制性气候变化披露, 社会和环境责任杂志 37, 203-221。

Gibassier, D. 和 S.Schaltegger, 2015, 碳管理会计和实践报告: 融合紧急方法的案例研究, 可持续性会计, 管理和政策期刊 6, 340-365。

Giner B. 2014 排放交易计划的会计:一个仍然开放的辩论 社会和环境责任杂志 34 45-51.

格雷 R. 2002 混乱 系统和可持续性:走向更多的社会和环境金融和会计 英国会计评论 34 357-386. Gray, R., 2010, Is accounting for sustainability actually accounting for sustainability? ..我们怎么知道? 组织与地球、会计、组织与社会的叙述的探索 35 47-62. Gray R. R.Kouhy And S.Lavers 1995 Corporate social and environmental reporting: a review of the literature and a study of UK disclosure Accounting Auditing and Accountability Journal 8 47-77.

Green W. 和 Q.Li 2012 温室气体排放保证预期差距的证据 会计 审计和责任杂志 25 146-173. Green, W. 和 S.Taylor, 2013, 影响对温室气体保证提供商质量看法的因素, 国际审计杂志 17, 288-307. Green W. And S.Zhou 2013 an international examination of assurance practices on carbon emissions disclosures Australian Accounting Review 23 54-66. 格里芬 P.A. 2013 限额和交易排放津贴和美国公司的资产负债表 可持续性会计 管理和政策杂志 4 7-31. 格里芬, P.A. 和 D.H.Lont, 2018, 改变游戏规则? 大众排放作弊丑闻对大型汽车制造商股票和信贷市场之间相互关系的影响, 当代会计与经济学杂志 14, 179-196.

- Griffin, P. A., and Y. Sun, 2013, Going green: market reaction to CSRwire news releases, *Journal of Accounting and Public Policy* 32, 93–113.
- Griffin, P. A., D. H. Lont, and E. Y. Sun, 2017, The relevance to investors of greenhouse gas emission disclosures, *Contemporary Accounting Research* 34, 1265–1297.
- Hahn, R., D. Reimsbach, and F. Schiemann, 2015, Organizations, climate change, and transparency, *Organization and Environment* 28, 80–102.
- Haigh, M., and M. A. Shapiro, 2012, Carbon reporting: does it matter?, *Accounting, Auditing and Accountability Journal* 25, 105–125.
- Haney, A. B., 2017, Threat interpretation and innovation in the context of climate change: an ethical perspective, *Journal of Business Ethics* 143, 261–276.
- Haque, F., 2017, The effects of board characteristics and sustainable compensation policy on carbon performance of UK firms, *The British Accounting Review* 49, 347–364.
- Haque, S., and C. Deegan, 2010, Corporate climate change-related governance practices and related disclosures: evidence from Australia, *Australian Accounting Review* 20, 317–333.
- Haque, S., C. Deegan, and R. Inglis, 2016, Demand for, and impediments to, the disclosure of information about climate change-related corporate governance practices, *Accounting and Business Research* 46, 620–664.
- Hartmann, F., P. Perego, and A. Young, 2013, Carbon accounting: challenges for research in management control and performance measurement, *Abacus* 49, 539–563.
- Haslam, C., J. Butlin, T. Andersson, J. Malamatenios, and G. Lehman, 2014, Accounting for carbon and reframing disclosure: a business model approach, *Accounting Forum* 38, 200–211.
- Hassan, A., and R. Kouhy, 2013, Gas flaring in Nigeria: analysis of changes in its consequent carbon emission and reporting, *Accounting Forum* 37, 124–134.
- Haupt, M., and R. Ismer, 2013, The EU Emissions Trading System under IFRS – towards a 'true and fair view', *Accounting in Europe* 10, 71–97.
- Herbohn, K., P. Dargusch, and J. Herbohn, 2012, Climate change policy in Australia: organisational responses and influences, *Australian Accounting Review* 22, 208–222.
- Herbohn, K., R. Gao, and P. Clarkson, 2019, Evidence on whether banks consider carbon risk in their lending decisions, *Journal of Business Ethics* 158, 155–175.
- Hollindale, J., P. Kent, J. Routledge, and L. Chapple, 2019, Women on boards and greenhouse gas emission disclosures, *Accounting and Finance* 59, 277–308.
- Hopwood, A. G., 2009, Accounting and the environment, *Accounting, Organizations and Society* 34, 433–439.
- Howard-Grenville, J., S. J. Buckle, B. J. Hoskins, and G. George, 2014, Climate change and management, *Academy of Management Journal* 57, 615–623.
- HRasky, S., 2012, Carbon footprints and legitimization strategies: symbolism or action?, *Accounting, Auditing and Accountability Journal* 25, 174–198.
- Huggins, A., W. J. Green, and R. Simnett, 2011, The competitive market for assurance engagements on greenhouse gas statements: is there a role for assurers from the accounting profession?, *Current Issues in Auditing* 5, A1–A12.
- Ioannou, I., S. X. Li, and G. Serafeim, 2016, The effect of target difficulty on target completion: the case of reducing carbon emissions, *The Accounting Review* 91, 1467–1492.
- Jeffrey, C., and J. D. Perkins, 2014, The relationship between energy taxation and business environmental protection expenditures in the European Union, *The International Journal of Accounting* 49, 403–425.
- Jeffrey, C., and J. D. Perkins, 2015, The association between energy taxation, participation in an emissions trading system, and the intensity of carbon dioxide

- Griffin, P.A.和Y.Sun, 2013, 走向绿色：市场对CSRWire新闻稿的反应，会计与公共政策杂志32, 93–113。Griffin, P.A., D.H.Lont和E.Y.Sun, 2017, 温室气体排放披露与投资者的相关性，当代会计研究34, 1265–1297。Hahn, R., D.Reimsbach和F.Schiemann, 2015, 组织, 气候变化和透明度, 组织和环境28, 80–102。Haigh, M.和M.A.Shapiro, 2012, 碳报告：重要吗？会计审计和责任杂志25 105–125。

Haney, A.B., 2017, 气候变化背景下的威胁解释和创新：道德视角，商业道德杂志143, 261–276。Haque F. 2017 theeffectsofboardcharacteristicsandsustainablecomp ensationpolicyonCARBONperformanceOFUKfirmsTheBritishAccountingReview49 347–364.Haque S. AndC.Deegan 2010 Corporateclimatechange–relatedgovernancepracticesandrelateddisclosures:evidencefromAustralia AustralianAccountingReview20 317–333.Haque S. C.Deegan AndR.Inglis 2016 Demandfor andimpilitiesto thedisclosure ofinformationaboutclimatechange–relatedcorporategovernancepractices Accountin gandBusinessResearch46 620–664.Hartmann F. P.Perego AndA.Young 2013 Carbonaccounting:challengesforresearchinmanagementcontrolandperformancemeasuremen t Abacus49 539–563.Haslam, C., J.Butlin, T.Andersson, J.Malamatenios和G.Lehman, 2014

碳核算和重构披露：商业模式方法 会计论坛38 200–211.

- Hassan, A.和R.Kouhy, 2013, 尼日利亚的天然气燃烧：对随之而来的碳排放和报告变化的分析，会计论坛37, 124–134。Haupt, M.和R.Ismer, 2013, IFRS下的欧盟排放交易系统–迈向“真实和公平的观点”，欧洲会计10, 71–97。Herbohn, K., P.Dargusch和J.Herbohn, 2012, 气候变化政策

澳大利亚:组织的反应和影响 澳大利亚会计评论22 208–222.Herbohn, K., R.Gao和P.C larkson, 2019, 关于银行在贷款决策中是否考虑碳风险的证据，商业道德杂志158, 155–175。Hollindale, J., P.Kent, J.Routledge和L.Chapple, 2019, 董事会和温室气体排放披露的女性，会计和财务59, 277–308。Hopwood A.G. 2009 会计与环境会计组织与社会34 433–439.

- Howard-Grenville, J., S.J.Buckle, B.J.Hoskins和G.George, 2014, 气候变化与管理，管理学院期刊57, 615–623。Hrasky, S., 2012, 碳足迹和合法化策略：象征主义还是行动？会计审计和责任杂志25 174–198.

Huggins, A., W.J.Green和R.Simnett, 2011, 温室气体报表保证业务的竞争市场：会计专业的assurers是否有角色？, 审计5, A1 A12中的当前问题。Ioannou, I., S.X.Li 和G.Serafeim, 2016, 目标难度对目标完成的影响：减少碳排放的情况，会计评论91, 1467–1492。Jeffrey, C.和J.D.Perkins, 2014, 能源税收与欧盟商业环境保护支出之间的关系，国际会计杂志49, 403–425。

- Jeffrey, C.和J.D.Perkins, 2015, 能源税，参与排放交易系统和二氧化碳强度之间的关联

- emissions in the European Union, *The International Journal of Accounting* 50, 397–417.
- Johnston, D. M., S. E. Sefcik, and N. S. Soderstrom, 2008, The value relevance of greenhouse gas emissions allowances: an exploratory study in the related United States SO₂ market, *European Accounting Review* 17, 747–764.
- Jung, J., K. Herbohn, and P. Clarkson, 2018, Carbon risk, carbon risk awareness and the cost of debt financing, *Journal of Business Ethics* 150, 1151–1171.
- Kim, S., W. J. Green, and K. M. Johnstone, 2016, Biased evidence processing by multidisciplinary greenhouse gas assurance teams, *Auditing: A Journal of Practice and Theory* 35, 119–139.
- Kolk, A., D. Levy, and J. Pinkse, 2008, Corporate responses in an emerging climate regime: the institutionalization and commensuration of carbon disclosure, *European Accounting Review* 17, 719–745.
- Kumarasiri, J., and A. Gunasekara, 2017, Risk regulation, community pressure and the use of management accounting in managing climate change risk: Australian evidence, *The British Accounting Review* 49, 25–38.
- Kumarasiri, J., and C. Jubb, 2016, Carbon emission risks and management accounting: Australian evidence, *Accounting Research Journal* 29, 137–153.
- Laughlin, R. C., 1991, Environmental disturbances and organizational transitions and transformations: some alternative models, *Organization Studies* 12, 209–232.
- Lee, K.-H., and Y. Wu, 2014, Integrating sustainability performance measurement into logistics and supply networks: a multi-methodological approach, *The British Accounting Review* 46, 361–378.
- Liao, L., L. Luo, and Q. Tang, 2015, Gender diversity, board independence, environmental committee and greenhouse gas disclosure, *The British Accounting Review* 47, 409–424.
- Liesen, A., A. G. Hoepner, D. M. Patten, and F. Figge, 2015, Does stakeholder pressure influence corporate GHG emissions reporting? Empirical evidence from Europe, *Accounting, Auditing and Accountability Journal* 28, 1047–1074.
- Liesen, A., F. Figge, A. Hoepner, and D. M. Patten, 2017, Climate change and asset prices: are corporate carbon disclosure and performance priced appropriately?, *Journal of Business Finance and Accounting* 44, 35–62.
- Linnenluecke, M. K., J. Birt, and A. Griffiths, 2015, The role of accounting in supporting adaptation to climate change, *Accounting and Finance* 55, 607–625.
- Liu, Z., S. Abhayawansa, C. Jubb, and L. Perera, 2017, Regulatory impact on voluntary climate change-related reporting by Australian government-owned corporations, *Financial Accountability and Management* 33, 264–283.
- Lodhia, S., and N. Martin, 2012a, The Garnaut Review: what do emissions-intensive trade-exposed industries really think about emerging climate change policies?, *Sustainability Accounting, Management and Policy Journal* 3, 33–49.
- Lodhia, S., and N. Martin, 2012b, Stakeholder responses to the National Greenhouse and Energy Reporting Act: an agenda setting perspective, *Accounting, Auditing and Accountability Journal* 25, 126–145.
- Luo, L., 2019, The influence of institutional contexts on the relationship between voluntary carbon disclosure and carbon emission performance, *Accounting and Finance* 59, 1235–1264.
- Luo, L., and Q. Tang, 2014a, Carbon tax, corporate carbon profile and financial return, *Pacific Accounting Review* 26, 351–373.
- Luo, L., and Q. Tang, 2014b, Does voluntary carbon disclosure reflect underlying carbon performance?, *Journal of Contemporary Accounting and Economics* 10, 191–205.

- Luo, L., and Q. Tang, 2016a, Determinants of the quality of corporate carbon management systems: an international study, *The International Journal of Accounting* 51, 275–305.
- Luo, L., and Q. Tang, 2016b, Does national culture influence corporate carbon disclosure propensity?, *Journal of International Accounting Research* 15, 17–47.
- Luo, L., Y.-C. Lan, and Q. Tang, 2012, Corporate incentives to disclose carbon information: evidence from the CDP Global 500 Report, *Journal of International Financial Management and Accounting* 23, 93–120.
- Luo, L., Q. Tang, and Y.-C. Lan, 2013, Comparison of propensity for carbon disclosure between developing and developed countries: a resource constraint perspective, *Accounting Research Journal* 26, 6–34.
- MacKenzie, D., 2009, Making things the same: gases, emission rights and the politics of carbon markets, *Accounting, Organizations and Society* 34, 440–455.
- Martinov-Bennie, N., 2012, Greenhouse gas emissions reporting and assurance: reflections on the current state, *Sustainability Accounting, Management and Policy Journal* 3, 244–251.
- Martinov-Bennie, N., and R. Hoffman, 2012, Greenhouse gas and energy audits under the newly legislated Australian audit determination: perceptions of initial impact, *Australian Accounting Review* 22, 195–207.
- Matsumura, E. M., R. Prakash, and S. C. Vera-Muñoz, 2014, Firm-value effects of carbon emissions and carbon disclosures, *The Accounting Review* 89, 695–724.
- McNicholas, P., and C. Windsor, 2011, Can the financialised atmosphere be effectively regulated and accounted for?, *Accounting, Auditing and Accountability Journal* 24, 1071–1096.
- Mete, P., C. Dick, and L. Moerman, 2010, Creating institutional meaning: accounting and taxation law perspectives of carbon permits, *Critical Perspectives on Accounting* 21, 619–630.
- Milne, M. J., and S. Grubnic, 2011, Climate change accounting research: keeping it interesting and different, *Accounting, Auditing and Accountability Journal* 24, 948–977.
- Momin, M. A., D. Northcott, and M. Hossain, 2017, Greenhouse gas disclosures by Chinese power companies: trends, content and strategies, *Journal of Accounting and Organizational Change* 13, 331–358.
- Moore, D. R. J., and K. McPhail, 2016, Strong structuration and carbon accounting: a position-practice perspective of policy development at the macro, industry and organizational levels, *Accounting, Auditing and Accountability Journal* 29, 1204–1233.
- Neu, D., H. Warsame, and K. Pedwell, 1998, Managing public impressions: environmental disclosures in annual reports, *Accounting, Organizations and Society* 23, 265–282.
- O'Dwyer, B., and J. Unerman, 2016, Fostering rigour in accounting for social sustainability, *Accounting, Organizations and Society* 49, 32–40.
- Olson, E. G., 2010, Challenges and opportunities from greenhouse gas emissions reporting and independent auditing, *Managerial Auditing Journal* 25, 934–942.
- Ott, C., F. Schiemann, and T. Günther, 2017, Disentangling the determinants of the response and the publication decisions: the case of the Carbon Disclosure Project, *Journal of Accounting and Public Policy* 36, 14–33.
- Qian, W., and S. Schaltegger, 2017, Revisiting carbon disclosure and performance: legitimacy and management views, *The British Accounting Review* 49, 365–379.
- Raibor, C., and M. Massoud, 2010, Emissions allowances: accounting and public policy issues, *Accounting and the Public Interest* 10, 105–121.

罗, L.和Q.Tang, 2016a, 企业碳管理系统质量的决定因素: 国际研究, 国际会计杂志51, 275–305。罗, L.和Q.Tang, 2016b, 国家文化是否影响企业碳披露倾向? 国际会计研究杂志15 17–47.Luo L. Y.-C.Lan AndQ.Tang 2012 企业激励披露碳信息:CDP全球500报告的证据 国际财务管理与会计杂志23 93–120。

Luo L. Q.Tang AndY.-C.Lan 2013 Comparisonofpropensityforcarbondisclosurebetweendevelopedcountries:aresourceconstraintperspective AccountingResearchJournal26 6–34.

MacKenzie, D., 2009, 让事情变得相同: 气体, 排放权和碳市场的政治, 会计, 组织和社会34, 440–455。Martinov-Bennie, N., 2012, 温室气体排放报告和保证: 对当前状态的反思, 可持续性会计, 管理和政策杂志3, 244–251。

Martinov-Bennie, N.和R.Hoffman, 2012, 新立法的澳大利亚审计决定下的温室气体和能源审计: 对初始影响的看法, 澳大利亚会计评论22, 195–207。

Matsumura, E.M., R.Prakash和S.C.Vera-Mu~noz, 2014, 碳排放和碳披露的公司价值影响, 会计评论89, 695–724。McNicholas, P.和C.Windsor, 2011, 金融化氛围能否得到有效监管和核算? , 会计, 审计和问责杂志24, 1071–1096。Mete, P., C. Dick和L.Moerman, 2010, 创造制度意义: 碳许可的会计和税法观点, 会计的关键观点21, 619–630。Milne, M.J.和S.Grubnic, 2011, 气候变化会计研究: 保持有趣和不同, 会计, 审计和问责期刊24, 948–977。Momin, M.A., D.Northcott和M.Hossain, 2017, 温室气体披露

中国电力公司: 趋势、内容和战略, 会计杂志和组织变革13, 331–358。

Moore, D.R.J.和K.McPhail, 2016, Strong structuration and carbon accounting: 宏观, 行业和组织层面政策发展的立场实践视角, 会计, 审计和问责期刊29, 1204–1233。Neu, D., H.Warsame和K.Pedwell, 1998, 管理公众印象: 年度报告, 会计, 组织和社会的环境心理披露23, 265–282。O'Dwyer, B.和J.Unerman, 2016, 培养对社会可持续性, 会计, 组织和社会会计的严谨性49, 32–40。Olson E.G. 2010 温室气体排放报告和独立审计的挑战和机遇 管理审计杂志25 934–942.Ott C.F.Schiemann Andt.g€unther 2017 Disentangling the determinants of the response and the publication decisions: The case of the Carbon Disclosure Project Journal Of Accounting and Public Policy36 1 4 33.

Qian W. AndS.Schaltegger 2017 Revising carbondisclosureandperformance:legitimacy andmanagementviews TheBritishAccountingReview49 365 379.Raibor, C.和M.Massoud, 2010, 排放津贴: 会计和公共政策问题, 会计和公共利益10, 105–121。

- Rankin, M., C. Windsor, and D. Wahyuni, 2011, An investigation of voluntary corporate greenhouse gas emissions reporting in a market governance system: Australian evidence, *Accounting, Auditing and Accountability Journal* 24, 1037–1070.
- Ratnatunga, J. T. D., and K. R. Balachandran, 2009, Carbon business accounting: the impact of global warming on the cost and management accounting profession, *Journal of Accounting, Auditing and Finance* 24, 333–355.
- Ratnatunga, J., S. Jones, and K. R. Balachandran, 2011, The valuation and reporting of organizational capability in carbon emissions management, *Accounting Horizons* 25, 127–147.
- Saka, C., and T. Oshika, 2014, Disclosure effects, carbon emissions and corporate value, *Sustainability Accounting, Management and Policy Journal* 5, 22–45.
- Sakhel, A., 2017, Corporate climate risk management: are European companies prepared?, *Journal of Cleaner Production* 165, 103–118.
- Simnett, R., M. Nugent, and A. L. Huggins, 2009, Developing an international assurance standard on greenhouse gas statements, *Accounting Horizons* 23, 347–363.
- Solomon, J. F., A. Solomon, S. D. Norton, and N. L. Joseph, 2011, Private climate change reporting: an emerging discourse of risk and opportunity?, *Accounting, Auditing and Accountability Journal* 24, 1119–1148.
- Spence, M., 1973, Job market signaling, *The Quarterly Journal of Economics* 87, 355–374.
- Stanny, E., 2018, Reliability and comparability of GHG disclosures to the CDP by US electric utilities, *Social and Environmental Accountability Journal* 38, 111–130.
- Stechemesser, K., and E. Guenther, 2012, Carbon accounting: a systematic literature review, *Journal of Cleaner Production* 36, 17–38.
- Subramaniam, N., D. Wahyuni, B. J. Cooper, P. Leung, and G. Wines, 2015, Integration of carbon risks and opportunities in enterprise risk management systems: evidence from Australian firms, *Journal of Cleaner Production* 96, 407–417.
- Tang, Q., 2017, *Towards a framework of carbon accounting and its role in corporate carbon management systems: a holistic approach*, Working paper. Available at: <http://dx.doi.org/10.2139/ssrn.2903366>
- Tang, Q., 2019, Institutional influence, transition management and the demand for carbon auditing: the Chinese experience, *Australian Accounting Review* 29, 376–394.
- Tang, Q., and L. Luo, 2014, Carbon management systems and carbon mitigation, *Australian Accounting Review* 24, 84–98.
- Tang, Q., and L. Luo, 2016, Corporate ecological transparency: theories and empirical evidence, *Asian Review of Accounting* 24, 498–524.
- Tang, Q., and L. M. Tang, 2019, Towards a distributed carbon ledger for the integration of carbon asset management and emissions trading, *Journal of Emerging Technologies in Accounting* 16, 37–46.
- Tauringana, V., and L. Chithambo, 2015, The effect of DEFRA guidance on greenhouse gas disclosure, *The British Accounting Review* 47, 425–444.
- Trotman, A. J., and K. T. Trotman, 2015, Internal audit's role in GHG emissions and energy reporting: evidence from audit committees, senior accountants, and internal auditors, *Auditing: A Journal of Practice and Theory* 34, 199–230.
- United Nations, 2019, *UN report: Nature's dangerous decline 'unprecedented'; species extinction rates 'accelerating'*. Available at: <https://www.un.org/sustainabledevelopment/blog/2019/05/nature-decline-unprecedented-report/>
- Verrecchia, R. E., 1983, Discretionary disclosure, *Journal of Accounting and Economics* 5, 179–194.
- Vesty, G. M., A. Telgenkamp, and P. J. Roscoe, 2015, Creating numbers: carbon and capital investment, *Accounting, Auditing and Accountability Journal* 28, 302–324.

- Rankin, M., C. Windsor and D. Wahyuni, 2011, 市场治理系统中自愿公司温室气体排放报告的调查：澳大利亚证据，会计、审计和问责期刊24, 1037–1070。
- Ratnatunga, J. T. D. and K. R. Balachandran, 2009, Carbonbusinessaccounting: theimpactofglobal warmingonthecostandmanagementaccountingprofessionals, JournalOfAccounting , AuditingandFinance24, 333–355。
- Ratnatunga, J., S. Jones and K. R. Balachandran, 2011, 碳排放管理组织能力的评估和报告，会计视野25, 127–147。
- Saka, C. and T. Osaki, 2014, 披露效应，碳排放和企业价值，可持续性会计，管理和政策杂志5, 22–45。

- Sakhel, A., 2017, 企业气候风险管理：欧洲公司是否做好了准备？，清洁生产杂志 165, 103–118。
- Simnett R. M. Nugent and A. L. Huggins 2009 Developing an international assurance standard on greenhouse gas statements Accounting Horizons 23 347–363.
- 所罗门, J.F., A. 所罗门, S.D. 诺顿和 N.L. 约瑟夫, 2011, 私人气候变化报告：风险和机会的新兴话语？，会计、审计和问责期刊24, 1119–1148。

- Spence, M., 1973, 就业市场信号，经济学季刊87, 355–374。
- Stanny E. 2018 美国电力公司向CDP披露温室气体的可靠性和可比性 社会和环境责任杂志38 111–130.
- techemesser, K. 和 E. Guenther, 2012, 碳会计：系统文献综述，清洁生产杂志36, 1 7–38。
- Subramaniam, N., D. Wahyuni, B. J. Cooper, P. Leung 和 G. Wines, 2015

- 企业风险管理中碳风险和机会的整合：澳大利亚公司的证据，清洁生产杂志96, 407–417。
- Tang, Q., 2017, 迈向碳核算框架及其在企业碳管理系统中的作用：整体方法，工作文件。可在:<http://dx.doi.org/10.2139/ssrn.2903366>唐Q. 2019 制度影响过渡管理和碳审计需求:中国经验 澳大利亚会计评论29 376–394.Tang Q. 和 L. Luo 2014 碳管理系统和碳缓解 澳大利亚会计评论24 84–98。

- 唐 Q. 和 L. 罗 2016 企业生态透明度:理论和经验证据 亚洲会计评论24 498–524.Tang, Q. 和 L. M. Tang, 2019, 迈向碳资产管理和服务交易整合的分布式碳分类账, 会计新兴技术杂志16, 37–46。Tauringana, V. 和 L. Chithambo, 2015, DEFRA指导对温室气体披露的影响, 英国会计评论47, 425–444。Trotman A.J. And K.T. Trotman 2015 Internal audit's role in GHG emissions and energy reporting: evidence from audit committee senior accountants and internal auditors Auditing: A Journal Of Practice and Theory 34 199–230.联合国, 2019, 联合国报告：大自然的危险下降“前所未有的”物种灭绝率“加速”。Http s: www.un.org/sustainabledevelopment博客2019/05/自然-衰退-史无前例-报告Verrecchia, R. E., 1983, 酝情披露, 会计与经济学杂志5, 179–194。Vesty, G. M., A. Telgenkamp 和 P. J. Roscoe, 2015, 创造数字：碳和资本投资, 会计, 审计和问责期刊28, 302–324。

- Warwick, P., and C. Ng, 2012, The 'cost' of climate change: how carbon emissions allowances are accounted for amongst European Union companies, *Australian Accounting Review* 22, 54–67.

Watkins, A. L., W. Hillison, and S. E. Morecroft, 2004, Audit quality: a synthesis of theory and empirical evidence, *Journal of Accounting Literature* 23, 153–193.

World Bank, Ecofys, and Vivid Economics, 2017, State and trends of carbon pricing 2017 (International Bank for Reconstruction and Development/The World Bank, Washington, DC). Available at: <https://openknowledge.worldbank.org/handle/10986/28510>

Yang, H. H., and A. Farley, 2016, Convergence or divergence? Corporate climate-change reporting in China, *International Journal of Accounting and Information Management* 24, 391–414.

Young, A., 2010, Greenhouse gas accounting: global problem, national policy, local fugitives, *Sustainability Accounting, Management and Policy Journal* 1, 89–95.

Yunus, S., E. Elijido-Ten, and S. Abhayawansa, 2016, Determinants of carbon management strategy adoption: evidence from Australia's top 200 publicly listed firms, *Managerial Auditing Journal* 31, 156–179.

Zhou, S., R. Simnett, and W. J. Green, 2016, Assuring a new market: the interplay between country-level and company-level factors on the demand for greenhouse gas (GHG) information assurance and the choice of assurance provider, *Auditing: A Journal of Practice and Theory* 35, 141–168.

- Watkins, A.L., W.Hillison和S.E.Morecroft, 2004, 审计质量: 理论和经验证据的综合, 会计文献杂志23, 153-193。世界银行, Ecofys和VividEconomics, 2017, 2017年碳定价的状态和趋势(国际复兴开发银行世界银行, 华盛顿特区)。[Https://openknowledge.worldbank.org处理1098628510](https://openknowledge.worldbank.org/retrieve/1098628510)杨 H.H. 和A.法利 2016 收敛还是发散?《中国企业气候变化报告》国际会计与信息管理杂志24 391-414。

- Young, A., 2010, 温室气体会计：全球问题，国家政策，地方逃犯，可持续性会计，管理和政策杂志1, 89–95。Yunus, S., E.Elijido-Ten和S.Abhayawansa, 2016, 碳管理战略采用的决定因素：澳大利亚前200家上市公司的证据，管理审计杂志31, 156–179。Zhou S.R.Simnett AndW.J.Green 2016 Assuringanewmarket:theinterplaybetweencountry-levelfactorsonthedemandforgreengas(GHG)informationassuranceandthechoiceofassuranceprovider Auditing:AJournalOfPracticeandTheory35 141–168.