学校编码：10384　　分类号_____密级 _____

学号：32420120153690　　UDC _____

厦门大学

博 士 学 位 论 文

中国供热如何摆脱高耗能低效率：基于能源、效率和热价视角

How to bail out heating industry from intensive energy consumption and low efficiency in China: from perspective of energy, efficiency and heating costs

林静

指导教师姓名：林伯强

专 业 名 称：能源经济学

论文提交日期：2017 年 4 月

论文答辩时间：2017 年 5 月

学位授予日期：2017 年　月

答辩委员会主席：_____

评　　阅　　人：_____

2017 年 5 月

厦门大学

博士学位论文

中国供热如何摆脱高耗能低效率：基于能源、效率和热价视角

How to bail out heating industry from intensive energy consumption and low efficiency in China: from perspective of energy, efficiency and heating costs

林静

厦门大学学位论文原创性声明

本人呈交的学位论文是本人在导师指导下,独立完成的研究成果。本人在论文写作中参考其他个人或集体已经发表的研究成果，均在文中以适当方式明确标明，并符合法律规范和《厦门大学研究生学术活动规范（试行）》。

本研究从选题、建模、结果分析再到政策建议，以及整体论文的写作都是与导师共同讨论、合作的过程和结果。

另外，该学位论文为（厦门大学能源经济与能源政策协同创新中心与中国能源经济研究中心）课题（组）的研究成果，获得（厦门大学能源经济与能源政策协同创新中心与中国能源经济研究中心）课题（组）经费或实验室的资助，在（厦门大学能源经济与能源政策协同创新中心与中国能源经济研究中心）实验室完成。（请在以上括号内填写课题或课题组负责人或实验室名称，未有此项声明内容的，可以不作特别声明。）

声明人（签名）：

年　　月　　日

厦门大学学位论文著作权使用声明

本人同意厦门大学根据《中华人民共和国学位条例暂行实施办法》等规定保留和使用此学位论文，并向主管部门或其指定机构送交学位论文（包括纸质版和电子版），允许学位论文进入厦门大学图书馆及其数据库被查阅、借阅。本人同意厦门大学将学位论文加入全国博士、硕士学位论文共建单位数据库进行检索，将学位论文的标题和摘要汇编出版，采用影印、缩印或者其它方式合理复制学位论文。

本学位论文属于：

（　　）1.经厦门大学保密委员会审查核定的保密学位论文，于　　年　　月　　日解密，解密后适用上述授权。

（　　）2.不保密，适用上述授权。

（请在以上相应括号内打“√”或填上相应内容。保密学位论文应是已经厦门大学保密委员会审定过的学位论文，未经厦门大学保密委员会审定的学位论文均为公开学位论文。此声明栏不填写的，默认为公开学位论文，均适用上述授权。）

声明人（签名）：

年　　月　　日

摘要

近年来，供热作为基础设施建设内容之一，快速发展。然而，中国供热以燃煤为主，1985-2014 年供热耗煤量占供热能源消费结构约 90%。供热属于高耗能高污染行业，供热燃煤排放成为中国大气污染不可忽视的因素之一。中国供热劣势在于高耗能、高排放、高投入、低产出。作为一项公共事业，供热不仅与民生息息相关，也与能源、环境紧密相连。研究中国供热如何走出高耗能低效率的困境，事关其未来可持续发展。本文从三个要点出发：能源、效率、价格。热价是考虑供热能源和效率问题不可忽略的部分。于是，针对这五个问题展开研究：（1）影响中国供热能源消费的因素以及中国供热是否能够节能？（2）如果中国供热能够节能，那么预期的节能目标是否能够全部实现？（3）中国供热生产要素是否实现资源优化配置？（4）中国供热生产要素的综合效率如何？（5）中国供热价格是否合理？基于此研究思路，本文通过分析中国供热的能源消费和节能潜力、能源反弹效应、投入要素和产出关系、全要素能源效率、二氧化碳排放效率和综合效率、供热成本、热价和补贴一系列问题来分析中国供热该如何摆脱高耗能低效率。

现有文献对于中国供热能源、效率的研究大部分从技术经济角度进行分析，从能源经济学理论角度进行论述的研究不多。本文从能源经济学视角出发，运用经济实证模型较完整地分析中国供热节能和效率问题，通过分析中国供热的能源消费、节能效果、生产投入要素与产出关系、全要素综合效率问题、供热成本、热价以及补贴一系列问题来探讨中国供热该如何摆脱高耗能低效率的困境。

研究结果表明：1985-2014 年，中国供热能源消费量与其他四个变量之间具有长期均衡关系：GDP 每增长 1%就会导致供热能源消费量增加 1.362%；城市人口密度、集中供热面积和能源价格水平每上升 1%将分别导致供热能源消费量下降 0.294%、0.138%和 0.071%。通过适当增加城市人口密度、提高能源价格、扩大集中供热面积等措施，2020 年，中国供热节能量能够达到 5501.58 万吨标煤，使得中国能源需求减少 1.15%。中国供热行业能源与劳动、资本的交叉价格弹性分别为 0.3737 和 0.2199；劳动与能源、资本之间的交叉价格弹性分别为 0.3793 和 0.1018；资本与能源、劳动的交叉价格弹性分别为 0.1188 和 0.0542。中国供热行业存在能源回弹效应为 39.96%。中国

供热行业投入要素配置没有实现资源优化配置，没有发挥对产出增长的最大作用：劳动投入要素积累效应最大，能源其次，资本最末；各投入要素都具备规模报酬递增，但规模递增效应逐渐减弱；资本依靠技术进步对产出增长影响最大，其次是能源，最后是劳动；技术进步贡献较低且非常缓慢，供热科技投入不足，技术作用不足。

1999-2014 年，中国热电行业全要素能源效率北方地区均值为 0.578，南方地区均值为 0.661；全要素二氧化碳排放效率北方地区均值为 0.547，南方地区均值为 0.649；全要素综合效率北方地区均值为 0.572，南方地区均值为 0.587。南方热电行业整体效率略高于北方。南方主要得益于技术进步，而北方主要得益于技术效率提高。但南北方热电行业的技术追赶作用都不明显。热成本占热电成本比例平均值北方比南方高，北方地区为 26.3%，南方地区为 24.1%。中国现行热价对热用户存在较为普遍的补贴现象，对居民用户的补贴多于对非居民用户的补贴。

关键词：供热节能；能源回弹；产出增长；全要素效率；供热成本及补贴。

Abstract

In recent years, heating industry develops rapidly as a part of infrastructure construction. Heating industry in China is mainly coal-fired heavy industry. Coal consumption accounts for 90% of the industry's total energy consumption during 1985-2014. As a result, heating industry's high energy consumption and emissions bring intensive pollution to the environment, especially in the main factor of atmospheric pollution in China. The disadvantages of heating industry are intensive energy consumption, high pollution, high input, but low output. As a public service, heating is closely related to the livelihood of the people, not only is closely connected with energy and environment. Therefore, it is of important practical significance to study how to bail out the heating industry out of the plight of intensive energy consumption but low efficiency, and guide the industry transit to sustainable development in the future. Embrace this core topic, this paper carries on the research from these three main points: energy, efficiency and price. The three points are close to each other. Then, this paper are built on these five questions: First, it is necessary to make sure what factors influence the energy consumption of heating industry in China and figure out its energy saving potential. Second, it has to figure out the real energy saving effect, that is, whether there is energy rebound effct. Third, analyzing the relation between input factors and outputs, especially the relationship between energy and outputs is important to energy conservation. Fourth, it is necessary to analyze the heating efficiency, especially the total-factor integrated efficiency. Fifth, heat pricing mechanism helps promote heating energy saving and efficiency improvement, how to rationalize heat tariff is the key to energy conservation and efficiency improvement. Based on this research idea, this paper carries on the sudy through a series of subjects combination, spicifically, the analysis of the factors affecting energy consumption and energy saving potential of the heating industry, the energy rebound effect, the relationship between input factors and outputs, total-factor energy efficiency and carbon dioxide efficiency and integrated efficiency, heating costs and subsidies.

Most of the existing literature about China's heating industry are from a technical point of view, discussions from the viewpoint of energy economic theory is still less, and, most of the existing literature just discussed a single question of heating industry in China, lacking

of systematically research on heating in China. This paper is from energy economics perspective, and uses economic empirical models to analyze heating industry in China completely. Through a series of analysis of the energy consumption of heating in China, energy saving potential and actual result, the relationship between the input factors and outputs, total-factor integrated efficiency, heating costs and subsidies to explore how to help heating in China to get rid of the plight of intensive energy consumption and low energy efficiency.

Research results show that during 1985-2014, a long-term cointegration relationship between the heating energy consumption and other four variables: 1% GDP growth will lead to the heating energy consumption increased by 1.362%; 1% rise in urban population density, central heating area and energy prices will lead to 0.294%, 0.138% and 0.071% decline in heating energy consumption. By increasing urban population density, raising energy prices, expanding central heating area, in 2020, energy saving can reach 5501.58 mtce in China's heating industry, which can reduce 1.15% of China's energy demand. Cross price elasticities of energy and labor, energy and capital, are 0.3737 and 0.2199 respectively. Cross price elasticities of labor and energy, labor and capital, are 0.3793 and 0.1018 respectively. Cross price elasticities of capital and energy, capital and labor, are 0.1188 and 0.0542 respectively. The energy rebound effect exists in the heating industry in China, which is 39.96%. Input factors configuration do not realize the optimal allocation in China's heating industry, leading to input factors can not play the largest effect economic growth of outputs. Labor input accumulation effect is the largest, and energy accumulation effect is the second largest, capital accumulation effect is the smallest. All inputs have increasing returns to scale, but the increasing scale effect is weakening. Capital rely on technological progress had the greatest influence on output economic growth, followed by energy, finally the labor. Technological progress contribution to the economic growth of outputs is weak and slow. Capital investment in science and technology in China's heating industry is insufficient. Efficiency of capital in China's heating industry needs to be improved.

During 1999-2014, the average total-factor energy efficiency of the thermal power industry is 0.578 in the north, and 0.661 in the south. The average total-factor of the thermal power industry CO_2 emissions efficiency is 0.547 in the north, and 0.649 in the south. The average total-factor integrated efficiency of the thermal power industry is 0.572 in the north, and 0.587 in the south. Total-factor efficiency of the industry in the south is slightly higher

than in the north. Technological advance is the source of adcance in the south, and technical efficiency is the source of adcance in the north. However, technological catch-up effect is not obvious in the north and the south thermal power industry. Average proportion of heating cost accounting for the thermoelectric cost is higher in the north than in the south, which is 26.3% in the north and 24.1% in the south. It is a common phenomenon in China that existing heat tariff subsidize heat users, specifically, the subsidies to residential users are much more than the non-residential users.

Keywords: heating energy conservation; energy rebound effect; economic growth of output; total-factor integrated efficiency; heating costs and subsidies.

目录

Content