

国家自然科学基金资助项目

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徐晔 陶长琪 著

Factor Agglomeration, Technology
Innovation and the Upgrading of
Regional Industrial Structure



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前言

中国经济在经历 30 多年的快速增长之后，无论是经济基本面，还是经济发展基本模式、产业形态以及经济增长动力已经今非昔比。与此同时，中国经济也面临着诸多问题。为了解决中国经济产能过剩、要素结构不合理、供求结构化失衡的问题，2015 年 11 月 10 日，习近平主席提出了供给侧结构改革，强调供给侧改革，就是要从生产、供给端入手，调整投入要素结构，实现产能结构化升级，在资源合理利用的基础上提高技术效率，为真正启动内需、打造经济发展新动力寻求路径。此外，作为经济全球化背景下一種特有的资源配置方式，要素集聚已经成为经济全球化的重要特征和基础。要素集聚通过规模效应通常对当地经济增长具有巨大的推动作用，但在区域经济增长过程中要注重经济与环境的协调。只有大力发展区域创新能力，推动区域经济增长模式由物质要素投入推动型转变为创新驱动型，才能实现区域经济发展由“数量型”向“质量型”增长转变。基于此，本书通过分析空间异质性视角下要素集聚对区域创新效率的影响，为要素驱动转化为创新驱动的路径选择提供建议；利用企业微观数据测算出制造业要素错配程度及其对技术效率的诱导性作用，探讨要素市场扭曲对技术效率提高诱致性作用的外在可持续性；分析环境规制下金融发展如何作用于技术创新，极大地丰富了金融要素促进技术创新的理论；以创新价值链理论为依托研究创新相关问题，为目前关于创新效率的研究提供了新的角度；分析技术创新各个子系统的动态涨落状况，展望技术创新的未来发展趋势；从区域产业创新系统技术驱动的角度探讨产业升级的演进机理；研究优化地区间环境规制资源配置的新路径，以及环境对要素集聚的影响和要素集聚条件下环境负面效应的形成；探索性地研究了要素集聚对区域创新能力的影响。

第一，我国经济的发展需要步入“新常态”，该状态下经济的发展与过去的不同特征之一就是要素驱动、投资驱动转向创新驱动。在“新常态”下，如何从要素驱动转化为创新驱动是亟须解决的问题。要素集聚对区域创新具有推动作用，要素集聚通过整合区域内外优势资源，对经济活动具有地理空间上的吸引力，并促进新企业或产业的衍生。要素在扩大集聚规模和空间的同时，也决定了该地区的比较优势。通过区域比较优势与集聚优势相互作用，生产要素尤其是人力资本集聚促进知识溢出和技术的转移扩散，降低技术创新风险，增大创新速度，推动区域创新能力和效率的提高。第一章做了如下研究：通过对我国区域要素集聚和区域创新效率的空间异质性实证研究，发现要素集聚和区域创新效率均存在着明显的空间异质性；门槛效应模型表明，要素集聚对区域创新效率的影响具有双重门槛效应，且人力资本集聚与区域创新效率呈倒 U 形关系，而物质资本和劳动力集聚则呈现先抑制后促进再抑制关系，可见要素集聚对区域创新效率的影响并不是一直都处



于促进状态,说明要素投入越多,区域创新效率并不一定会越高。通过第一章研究得到:空间异质性视角下人力资本集聚和物质资本集聚为正值,劳动力为负值;物质资本通过资本的投入为企业和高校等主要的创新主体带来了更多的资金支持,从而吸引更加优秀的人才参与区域创新,增加区域创新效率;人力资本集聚通过对知识、技术的承载和溢出效应加强了知识创造和知识流动能力,对区域创新能力的提升表现出明显的促进作用,同时通过对比分析不考虑空间异质性的 OLS 回归发现,加入了空间异质性后模型的拟合程度变高了,对照各变量系数可发现物质资本对区域的促进作用变得更加显著,已超过了人力资本,说明加入空间异质性后,资金的作用更加显著,所以各地区在考虑提高人力资本的同时也要考虑该地区物质资本投入是不是已经到位了。

第二,一国制造业的发展水平是衡量国家竞争力的重要指标。当前,中国经济发展状况尤其严峻。在这样一个时代背景和改革环境之下,认清制造业当前面临的形势,分析制造业存在的问题,对推动制造业结构化升级与发展具有重要意义。首先,采用超越对数生产函数取代 C-D 生产函数对 HK 模型加以改进,然后结合一般均衡理论、新古典经济增长理论构建了一套从静态到动态的理论分析框架,从理论模型的角度显示了技术效率和要素错配的负相关关系;其次,通过动态面板模型从制造业企业微观层面计量分析了要素错配与技术效率之间的关系,从实证研究的角度印证了理论模型的正确性和可靠性,在理论与实证相呼应的基础上验证了中国制造业当期要素错配会降低技术效率,并补充说明了前期要素错配会提高技术效率这一延迟效应,从而弥补了国内该领域作用机制研究的空白;最后,注重估计结果的稳健性,在考虑要素错配对中国制造业技术效率的影响时,使用多种估计方法和测度方法,并谨慎选择滞后结束,且加强模型设定检验和平稳性检验,以确保估计系数及模型的稳健性。通过第二章研究得到:技术效率与要素错配之间存在着负相关关系,这表明当一个制造业企业要素错配严重时,它的技术效率会下降;通过加入要素错配滞后项的动态面板模型的实证研究,发现当期要素错配确实对技术效率存在着负向影响,但滞后项则与当期技术效率呈正相关关系;在模型中加入所有制作为政策变量后,结果显示,技术效率有显著的所有制差异,且国有企业对技术效率的影响是负向的,外资企业和其他企业对技术效率的作用则是正向的,这表明国有企业由于制度腐败陈旧、对政府依赖性太强而存在许多潜在的经济发展问题,如产能过剩、要素结构不合理、供求结构失衡等。

第三,技术创新是经济持续增长的原动力,而资金是技术创新的必要要素之一。首先,介绍了内生增长模型和面板门槛效应模型,并从两个层次分析金融发展与技术创新的关联性;其次,分析了金融发展促进技术创新的机理,进一步将技术创新分解为技术开发和技术转化两个阶段,构建面板门槛回归模型分析金融发展与技术开发和技术转化之间的关系;最后,介绍了环境规制下金融发展促进技术创新的机理分析,构建面板门槛效应模型分析金融发展对技术开发和技术转化的溢出效应并进行比较分析,深入探讨金融发展对技术创新的作用。通过第三章研究得到:当金融发展水平较低时,金融发展不能够促进技术开发,随着金融发展水平的提高,金融发展能够有效地促进技术开发,但当金融发展水平继续提高时,金融发展对技术开发的促进作用不显著;同样,低水平的金融发展也不能够有效地促进技术转化,但随之提高,金融发展能显著地促进技术转化且促进作用越来越强,因此金融发展与技术转化之间呈现 U 形关系。在金融发展溢出效应的作用下,环境



规制与技术转化之间仍存在单重门槛效应,适当强度的环境规制能有效地促进技术转化,但当环境规制超过门槛值后,环境规制会阻碍技术转化,金融发展的溢出效应可以补偿一部分环境规制对技术转化的挤占效应。

第四,创新带动技术进步、促进经济持续稳定增长,从而提升我国的综合国力。它是现代社会各方面得以向前发展的支撑点,融入社会生活的方方面面。2016年是“十三五”规划的开局之年,中国进入社会经济换挡升级、引擎更迭的关键时期,认清当前我国创新面临的背景,有助于创新主体间科学、合理配置和运用资源,提高创新效率,以新技术带动国家富强,提升我国国际地位。首先,从我国面临的环境出发,结合我国目前创新的实际情况及已有的理论研究基础,从理论上将创新价值链分成三个阶段即基础研究阶段、应用研究阶段、产品研究阶段,以高校、科研机构、企业等创新主体为载体,建立 Malmquist 模型测度创新全要素生产率;其次,通过空间滞后模型(SLM)分析全要素生产率溢出效应考察价值链各阶段前后联动效应,进而分析不同影响因素对不同创新主体的作用;最后,建立平滑转移模型(PSTR)分析政府针对不同研发主体投入资金的门槛值,为政府合理的资金投入促进全要素生产率的提升提出政策建议。通过第四章研究得出:基础研究与产品研究创新全要素生产率略高于应用研究创新全要素生产率,区域上创新全要素生产率平均增长速度均呈现由东部到西部逐渐递减的特征。这表明我国区域创新能力存在差别,价值链各阶段间创新能力也存在差异。在此基础上分析创新全要素生产率溢出效应,实证结果表明创新价值链三阶段均存在正向溢出效应:基础研究阶段,产品研究创新全要素生产率形成的外溢效应更明显;应用研究阶段,产品研究创新全要素生产率的溢出效应更显著;产品研究阶段,应用研究全要素生产率具有更明显的外溢效应。实证结果充分表明现阶段高校与企业、科研机构与企业联系较为紧密而高校与科研机构间互动较少。

第五,技术创新是衡量区域经济状况以及区域竞争实力的重要指标。探究省域技术创新能力,对明晰我国各省、经济圈乃至全国的技术创新内在驱动力,考察知识溢出对技术进步的促进作用,从而深度分析区域技术与区域创新的耦合效应,并推进区域产业部门的协调均衡发展,分析技术创新各子系统的动态涨落状况,展望技术创新的未来发展趋势,具有不可或缺的意义。首先,对小波分析、改进的灰熵 TOPSIS 法等进行了详细的理论阐释,总结了各类多属性综合评价方法的优缺点。其次,以省域技术创新能力为研究背景,解析了技术创新能力的含义,并构建省域技术创新能力评价指标体系;对全国 31 个省市 1995~2011 年的时间序列数据进行小波分解,根据小波分析的能量守恒定律,选取小波分解后的能量与指标权重的加权和来表示各省的技术创新能力;用熵值法、灰熵 TOPSIS 法和 WP 法对我国 31 个省市的技术创新能力进行分析;基于上述结果,对省域技术创新能力进行影响因素分析。最后,从省域经济综合竞争力提升、科技资源投入产出增加和技术创新环境优化的角度,分析如何增强三大经济地带的技术创新能力,并选择以经济集聚区为中心的经济辐射路径。通过第五章研究得到:通过检验实证结果与区域创新能力报告综合排名与 Spearman 等级相关度,表明 WP 法在揭示省域技术创新的经济圈集聚现象和省域技术创新能力排名的准确性方面明显优于其他几种方法;而准确定位产学研机构的职能,有效利用知识、技术的溢出效应,便于实现技术创新资源禀赋的合理化配置,协调化调配产业间的比例,实现技术创新的高效化,为省域技术创新能力的提升、区域技术创新能力的协同发展、全国技术创新网络的构建提供依据,最终为实现经济的持续稳步发



展提供科技支持。

第六,在国际金融危机的考验下,很多国家和地区开始意识到只有通过产业创新,推动产业结构优化升级,才能在越来越激烈的经济竞争中占据优势,培育出新的经济增长点,产生更大的经济效益;而区域产业创新与产业升级在一定程度上总是相互关联、相互作用的。因此,我们有必要对区域产业创新和产业升级耦合情况加以分析,以帮助我们更好地构建区域产业创新系统,推动区域产业结构优化升级。借助物理学上的耦合概念,系统性地分析了区域产业创新与产业升级耦合机制。首先,对区域产业创新与产业升级基础理论加以研究,明确分析了区域产业创新系统的内涵和构成要素,同时对产业升级的内涵和标志加以研究分析。其次,对区域产业创新与产业升级耦合系统的构成和耦合内容展开了详细、具体的分析。再次,系统性地分析了区域产业创新与产业升级的运行机制,主要是从基于市场需求的技术驱动机制、基于创新转化的技术传导和基于环境支撑的政策推动三个方面展开分析的。最后,构建了区域产业创新与产业升级耦合模型,并通过实证研究,分析了我国区域产业创新与产业升级的耦合度情况。通过第六章研究得到:确定了区域产业创新系统和产业升级系统两大系统之间的耦合机制及耦合模型;明确了区域产业创新与产业升级耦合在一定情况下与当地产业的创新情况和在产业结构调整方面所做的工作有关,那些区域内创新活动活跃,产业结构合理,区域内高新技术产业多,传统产业慢慢实现转移的地方往往耦合相关度和耦合协调度都要好一些。

第七,从两个层次进行了关联性研究,分别是产业结构与全要素生产率的关联性分析以及双重环境规制约束下产业结构与全要素生产率的关联性分析;介绍了产业结构对全要素生产率的作用机理,并建立动态面板模型,将产业结构从横向和纵向两个维度衡量,分为产业结构合理化和产业结构高级化,实证分析了产业结构合理化、高级化与全要素生产率及其组成部分作用的关系。实证结果表明产业结构调整升级有利于提高全要素生产率,产业结构升级更能带动全要素生产率的提高。进一步研究双重环境规制下产业结构对全要素生产率的作用机理,利用我国1998~2015年的省际面板数据,构建面板模型和门槛模型,比较正式环境规制与非正式环境规制下,产业结构对全要素生产率作用路径的不同,依据门槛区间分析我国各省环境规制资源配置状况,并找出差异原因。通过第七章研究得出:正式环境规制约束下,产业结构合理化、高级化与全要素生产率呈负相关关系;非正式环境规制约束下,产业结构合理化、高级化与全要素生产率呈正相关关系;正式环境规制存在单一门槛,低强度的正式环境规制不利于产业结构促进全要素生产率,当正式环境规制跨越门槛的限制后,产业结构有利于产业结构带动全要素生产率,即正式环境规制下产业结构与全要素生产率呈U形关系;非正式环境规制存在双重门槛,产业结构合理化在非正式环境规制位于门槛值之间时,对全要素生产率的刺激效应最大,而产业结构高级化随非正式环境规制水平的提高,对全要素生产率的正向效应增强。依据门槛区间,将我国各省环境规制资源配置状况划分成一个“双优”组、两个“单优”组和一个“双非优”组。

第八,作为经济全球化背景下一特有的资源配置方式,要素集聚已经成为经济全球化的重要特征和基础。要素集聚通过规模效应通常对当地经济增长具有巨大的推动作用,但在区域经济增长过程中要注重经济与环境的协调。只有大力发展区域创新能力,推动区域经济增长模式由物质要素投入推动型转变为创新驱动型,才能实现区域经济发展由“数量型”向“质量型”的增长转变。在回顾要素集聚、区域经济发展理论的基础上从时

空的维度揭示环境约束下要素集聚促进区域经济协调可持续发展的内在作用机理。第八章以二氧化碳的排放作为环境污染的替代变量,测度我国各地区能源消耗所产生的碳足迹;依次测度劳动力、物质资本和人力资本的集聚密度、区位熵和空间自相关性;将环境质量作为内生要素同时引入生产函数与效用函数,利用动态优化作为基本分析工具,得到最优稳态增长解;构建局部溢出模型,分析要素空间集聚的需求关联、溢出等外部规模经济效应与环境污染、拥挤等外部不经济效应对区域经济协调发展的作用机制;构建区域经济合作的博弈模型分析区域合作效用的分配问题和合作机制的形成。通过第八章研究得出:①要素集聚、区域经济发展与环境的互动机制。以二氧化碳的排放作为环境污染的替代变量,测度我国各地区能源消耗所产生的碳足迹。依次测度劳动力、物质资本和人力资本的集聚密度、区位熵和空间自相关性,发现劳动力、物质资本和人力资本都高度集聚,人力资本专业化程度最大,物质资本的趋利性和人力资本的溢出效应都使其容易表现出显著的空间正相关,呈现出高高或低低集聚的空间分布格局。利用 Divisia 指数分解法,分析了区域经济增长对环境污染排放量的规模效应、技术进步效应、区域产业结构效应和空间结构效应。结果表明,规模效应和区域产业结构的不合理为环境污染加重的主要原因,区域空间结构效应对环境质量的改善起到不利的影响;技术效应对环境质量的改善起到正向促进作用。②环境约束下要素集聚对区域经济可持续发展的内生机制。利用面板固定效应模型对区域经济发展的影响因素进行实证分析,结果显示,资本深化显著促进劳动生产率的提高;物质资本集聚与区域经济增长之间存在倒 U 形关系,物质资本过度集聚阻碍了劳动生产率的提高;人力资本集聚对劳动生产率具有显著的促进作用;无效环境效率对劳动生产率的提高具有显著的阻碍作用;只有人力资本集聚对区域创新有一定的吸收作用,通过作用于区域创新能力间接促进区域经济发展,物质资本集聚带来的资本深化并不能作用于区域创新能力。③环境约束下要素集聚与区域经济协调发展的作用机制。在区域经济合作优势的分析基础上,构建区域经济合作的博弈模型分析区域合作效用的分配问题和合作机制的形成。研究发现,参与合作的各地方政府给联盟带来经济效用增量和环境效用损失,两者的差值是参与合作的各地方政府给联盟带来的净效用,根据此比例分配区域经济合作中获得的效用。

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由于作者水平有限,本书的缺点在所难免,敬请专家、学者及读者不吝指正。

徐晔 陶长琪
于江西财经大学蛟桥园
2016年10月

Preface

The economy of China experience rapid growth about 30 years, the economic fundamentals, the basic pattern of economic development, pattern of industry and economic growth momentum have changed a lot. At the same time Chinese economy is also facing many problems, in order to solve the problems of economic overcapacity, unreasonable factor structure, and the imbalance of supply and demand structure, November 10th, 2015, president Xi Jinping proposed the “supply side” structural reform, emphasized the supply side reforms start from the production, supply side, adjust the input structure, implementation capacity of structured upgrade, improve the technical efficiency based on reasonable utilization of resources, to start domestic demand create a new impetus for economic development. In addition, as a special resource the configuration mode under the background of economic globalization, agglomeration has become an important feature of economic globalization and basic elements set together. A scale is usually has great role in promoting local economic growth, but in the process of regional economic growth should pay attention to the coordination of economy and environment. Only to develop regional innovation capacity, promote regional economic growth pattern from the material elements of investment to promote the transition to innovation driven regional economic development, in order to achieve the transition from “quantity” to “quality” growth. Based on this, the book analyzes the spatial heterogeneity from the perspective of agglomeration effect on regional innovation efficiency, as the factor driven into path driven by innovation and provide suggestion; using firm level data to calculate the manufacturing factors on the technical efficiency and the degree of mismatch induced effects on to improve the efficiency of technology factors market distortion external sustainability induced effect; analysis of environmental regulation and financial development play a role in technology innovation, Enrich the financial elements of promoting technology innovation theory; innovation related issues based on value chain theory, for the current research on the innovation efficiency and provide a new perspective; analysis of dynamic fluctuations of technological innovation of each subsystem, the development trend in the future prospects of technological innovation; explore the evolution mechanism of industrial upgrading from driving the technology of regional industrial innovation system perspective; new path of regional environmental regulation to optimize the allocation of resources, the formation of the negative effects of environmental conditions and environmental impact on agglomeration and agglomeration, the agglomeration effect of regional innovation capability is also explored.



Firstly, the economic development of China needs to enter the “new normal”, the development state has the different characteristics of the past, one of is from the factor driven, investment driven to innovation driven. In the “new normal”, how to change the driving force from factor to innovation is an urgent problem. Factors cluster has promoting effects on regional innovation, which by integrating regional advantage resources inside and outside to attract economic activity and promote a new business or industry. Derived elements in expanding the scale gathering space and at the same time, also determines the comparative advantages of the region. The regional comparative advantage and agglomeration interaction, especially the factors of production the concentration of human capital to promote the transfer of knowledge spillover and technology diffusion, reduce the risk of technological innovation, increase the speed of innovation, promote regional innovation ability and efficiency of the first high. Chapter of the research are as follows: firstly by studying the spatial heterogeneity of empirical and regional innovation efficiency of China's regional agglomeration, agglomeration and regional innovation efficiency found there were obvious spatial heterogeneity. The model shows that the effect of threshold effect of agglomeration on regional innovation efficiency has a double threshold effect, and the concentration of human capital inverted U type relation with regional innovation efficiency, physical capital and labor agglomeration is presented first and then suppress the relationship between inhibition and promotion, visible agglomeration effect on regional innovation efficiency is not always in promoting the state that more inputs, regional innovation efficiency is not necessarily higher. By the first chapter of the study: from the perspective of spatial heterogeneity of human capital and physical capital agglomeration is positive, negative labor; physical capital through capital investment for enterprises and universities etc. The main subject of innovation has brought more financial support, in order to attract more talent to participate in regional innovation, increase regional innovation efficiency; while the human capital agglomeration based on knowledge, capacity and technology spillover effect to strengthen the knowledge creation and knowledge flow, on the regional innovation capability showed obvious promotion at the same time. Through the comparative analysis without considering the spatial heterogeneity of OLS regression showed that joined the fitting degree of spatial heterogeneity of the model becomes higher, the control coefficient of each variable can be found in physical capital to promote the region become more significant, more than human capital, which show that the addition of spatial heterogeneity, the role of the funds is more significant. So the area in consideration of improving human capital should also take into account the area of material capital investment was not also been in place.

Secondly, the development level of a country's manufacturing industry is an important indicator to evaluate national competitiveness. At present, the development of China's economic situation is particularly serious. Under such a background and reform environment, understand the manufacturing current situation, analysis of manufacturing problems, which is of great significance to promote the manufacturing industry structure upgrading and development. Do pioneering work of the second chapter is mainly reflected in: first, using the trans log production function to replace the C - D production function improved the HK model, and then combined with the gen-

eral equilibrium theory, the new classical economic growth theory to construct a set from static to dynamic theoretical framework, from the theoretical model point shows the negative correlation between technology efficiency and factor mismatch; second, the relationship between the elements of dynamic panel model mismatch and the technical efficiency of manufacturing enterprises is analyzed from the micro level measurement, from the real research angle proved the correctness and reliability of theoretical model, based on theory and empirical echoes verified on the current China elements manufacturing mismatch will reduce the efficiency, and added the previous element mismatch will improve the technical efficiency of the delayed effect, which make up the blank in the field of domestic research mechanism third, pay attention to the estimation results; the robustness in consideration of mismatch on technical efficiency China manufacturing effect, using various estimation methods and measurement methods, and careful selection of lag ends, and strengthen the model set test and stability test, to ensure that the estimated coefficients and the robustness of the model. Get through the second chapter study: there is a negative correlation between technical efficiency and factors of mismatch, it shows that when a manufacturing enterprise factor mismatch is serious, its technical efficiency will decline; through empirical research on the dynamic panel model with elements of the consequent mismatch lag, the current mismatch is found factors on technical efficiency there is a negative impact, but the lag is positively correlated with the technical efficiency; add all production display results for policy variables in the model, the technical efficiency of ownership differences, and the impact on the technical efficiency of state-owned enterprises is negative, the effect of foreign investment enterprises and other enterprises on the technical efficiency of the is positive, which indicates that the state-owned enterprises due to the system of government corruption is obsolete, dependence is too strong and there are many potential problems of economic development, such as overcapacity, unreasonable structure of supply and demand factors, structural imbalance and so on.

Thirdly, technological innovation is the source of economic growth, but the fund is one of the necessary elements of technological innovation. The third chapter introduces the endogenous growth model and panel threshold model, and analysis from the two levels of relevance and technological innovation of financial development. Then we analyzes the mechanism of financial development promoting technological innovation. Further technological innovation can be decomposed into technology development and technology into two stages, to construct a panel threshold regression model to analyze the relationship between financial development and technology development and technology transformation. Finally introduces the analysis of mechanism of technological innovation and financial development to promote environmental regulation, construction of panel threshold effect model analysis on Spillover Effect of financial development on technology development and technology the transformation and comparative analysis, in-depth study of the financial development of the role of technological innovation. The third chapter is obtained when the financial development level is low. That financial development can promote the development of technology, with the financial development, financial development can promote the development of effective technology, but when the level of financial development continues to improve, the finan-



cial development of the technical development of the role is not significant; the same low level of financial development cannot effectively promote the transformation of technology, but increase. Financial development can significantly promote technological transformation and promote more and more strong, thus showing “U” relationship between financial development and technological transformation. The Spillover Effect of financial development under the action of still single threshold effect between environmental regulation and technological transformation, environmental regulation with proper strength can effectively promote the transformation of technology, but when the environmental regulation exceeds the threshold value, environmental regulation will hinder technological transformation, the spillover effect of financial development can compensate a part of environmental regulation on misuse of technology transformation effect.

Fourthly, innovation drives the technological progress to promote sustainable economic growth, and enhance the comprehensive national strength of our country. It is a point to move forward, and integrate into all aspects of modern society. It is the support of all aspects of modern society development, integrated into all aspects of social life in. 2016 is “13th Five - Year” plan at the beginning of the year, Chinese entered the social economic shift upgrade, the key period of the engine change the understanding of innovation of current our country is facing the background, contribute to the innovation of scientific, rational allocation and use of resources, improve the efficiency of innovation, with new technology to promote the prosperity of the country, to enhance China’s international status. The fourth chapter first from China is faced with the environment, combined with the actual situation and existing at present in our country innovation. The study of basic theory, theory innovation value chain can be divided into three stages based on the stage, the stage of applied research, product research stage, to colleges and universities, scientific research institutions, enterprises and other innovation main body as the carrier Body, establish Malmquist model to measure the total factor productivity through innovation. Secondly, spatial lag model (SLM) analysis of the Total Factor Productivity Spillover Effect of before and after each stage of the value chain linkage effects, and then analyzes the different influential factors on the different subjects of innovation. Finally, establish a smooth transition model (PSTR) analysis of Government R&D investment funds for different subjects the threshold value, and put forward some policy suggestions to the government reasonable capital investment to promote the improvement of TFP. The fourth chapter studies, basic research and product innovation on the total factor productivity is slightly higher for the applied research and innovation TFP, innovation TFP regional average growth rate showed a gradually decreasing from the east to the West. This shows that features the regional innovation ability of our country is different, each stage of the value chain between the innovation ability are also different. Based on the analysis of innovation Total Factor Productivity Spillover Effect, empirical results show that there are positive spillover effects of innovation value chain three stages. The basic research stage, product research and innovation spillover effect of TFP formation is more obvious; the stage of applied research, product research and innovation spillover effect of TFP is more significant; product research, application research of TFP has a spillover the effect is more obvious. In the fourth chapter, empirical results show that

universities and enterprises at the present stage, scientific research institutions and enterprises are closely linked and less interaction between universities and research institutions.

Fifthly, technological innovation is an important index to measure the regional economic situation and regional competitiveness. To explore the provincial technology innovation ability, to clarify China's provinces, economic circle and even the country's internal technological innovation driving force, promote the study of knowledge spillover on technological progress, and depth analysis of regional and regional technology innovation coupling. And promote the balanced development of regional industry, analysis of the dynamic fluctuations of technology innovation subsystem, the development trend of the future prospects of technological innovation, has an important significance. The fifth chapter, firstly, wavelet analysis, improved gray entropy method of a theoretical explanation in detail, summarizes the advantages and disadvantages of various types of multi attribute comprehensive evaluation methods; Then, the technological innovation ability in the province for the research background, analysis of technology innovation ability connotation, and construct the technological innovation ability evaluation index system of provincial; Then the time series data of 31 provinces in China from 1995 to 2011, the wavelet decomposition, according to the law of conservation of energy of wavelet analysis, and selects the energy weighted index weights after wavelet decomposition and representation of the technology innovation ability; with the entropy method, analyze the technology innovation ability of 31 provinces in China in the gray entropy method and method; then based on the above results, analyzes the influencing factors of technical innovation ability of domain; finally from the overall competitiveness of provincial economy, science and technology resource input and output angle increase and technological innovation environment optimization, analysis of how to strengthen the three major economic zones and economic and technological innovation capability, select the radiation path to economic agglomeration as the center in the fifth chapter. The conclusion is that the report and the regional innovation ability through the empirical test results and ranking the correlation degree, that method in revealing the provincial. With innovative economic circle agglomeration phenomenon and the ranking of provincial technology innovation capability of the accuracy was significantly better than the other methods. And the accurate positioning of research institutions, the effective use of knowledge, technology spillover effect, easy to realize reasonable technological innovation resources allocation, coordination between the industry proportion, to achieve high efficiency of technology for innovation, the technical innovation ability of domain promotion, the coordinated development of the regional technological innovation ability, provide the basis for the construction of the national technology innovation network, ultimately providing scientific and technological support to achieve the sustained and steady economic development.

Sixthly, in the international financial crisis, many countries and regions have begun to realize that only through industrial innovation, promote the optimization and upgrading of industrial structure, to occupy the advantage in the increasingly fierce economic competition, cultivate new economic growth point, resulting in greater economic benefits. To a certain extent always correlation region industrial innovation and industrial upgrading, interact with each other. Therefore, it



is necessary for regional industrial innovation and industrial upgrading coupling is analyzed, in order to build to help us better regional industrial innovation system, promote the optimization and upgrading of regional industrial structure. The sixth chapter with the coupling concept of physics, systematic analysis of the regional industry innovation and industry upgrade the coupling mechanism. Analysis from the following aspects: one is to study the regional industry innovation and industry upgrading theory, it analyzes the producing areas the connotation of industry innovation system and the elements, and to research and analysis of the connotation and symbol of industrial upgrading; two is coupled to the regional industrial structure and the content of innovation and industrial upgrading of coupled system of specific detail; three is systematically analyzed the operation mechanism of regional industrial innovation and industrial upgrading, mainly from the driving mechanism of market demand based on the technology, based on technology innovation and transformation of the conduction and environmental support to promote policies based on the analysis of three aspects; finally, the sixth chapter based on the above analysis, the regional industrial innovation and industrial upgrading coupling model, and through empirical research, analysis of China's regional industrial innovation and the coupling degree of industrial upgrading. The sixth chapter studies: determine the coupling mechanism between regional industrial innovation system and industrial upgrading system two system and coupling model; clear the innovation of regional industrial innovation and industrial upgrading in certain circumstances coupled with local industry and in the adjustment of industrial structure, the innovation activities in the region active. The reasonable industrial structure, high-tech industries in the region, the traditional industry slowly realize the transfer of the place often coupling degree and coupling coordination degree are better.

Seventhly, the relevance study from two levels, analysis of correlation between industry structure and TFP in the double under environmental regulation; introduces the mechanism of industrial structure on total factor productivity, and establish a dynamic panel model, the industrial structure from the horizontal and the two dimensions of the vertical measure, divided into the industrial structure rationalization of industrial structure and the empirical analysis, rationalization of industrial structure upgrade and TFP and its component interaction. The empirical results show that the adjustment and upgrade of industrial structure is conducive to the improvement of total factor productivity, the upgrading of the industrial structure but also promote the improvement of total factor productivity. Further study on the mechanism of the industrial structure of double environmental regulation on total factor productivity, use of our 1998 - 2015 provincial panel data, construction surface plate model and threshold model, more formal and informal environmental regulation environmental regulation under different industrial structure on the TFP path, based on threshold interval analysis for our provincial environmental regulation of the allocation of resources, and find out the reasons for the differences. The seventh chapter studies: a formal environmental regulation, rationalization of industrial structure is advanced negative correlation with total factor productivity, informal environmental regulation, the rationalization of industrial structure, advanced and total factor TFP positively relationship. There is a single threshold of formal



environmental regulation; formal environmental regulation is not conducive to the low intensity of the industrial structure to promote total factor productivity, as the official environmental regulation beyond the threshold limit. The industrial structure of the industrial structure led to total factor productivity, namely formal environmental regulation of industrial structure and total factor productivity in a “U” relationship. There is a double threshold of formal environmental regulation, the rationalization of industrial structure in the informal environmental regulation in the threshold value when the stimulation effect on TFP, and upgrading the industrial structure with the informal environmental regulation level, a positive effect on total factor productivity should be stronger. On the basis of the threshold interval, divides the environmental regulation of resource allocation the status of China as a “Hasang” group, two “single” group and a “double non optimal” group.

Eighthly, as a special way of resource allocation under the background of economic globalization, agglomeration has become an important feature and the foundation of economic globalization. The agglomeration scale is usually on the local economic growth plays an important role in promoting regional economic growth, but in the process we should pay attention to the coordination of economy and environment. Only to develop regional innovation ability, to promote regional economic growth pattern from the material elements of investment to promote the transition to innovation driven regional economic development, in order to achieve the transition from “quantity” to “quality”. The eighth chapter reviews the growth in agglomeration, based on theory of regional economic development from the time dimension to reveal the environmental constraints agglomeration promoting intrinsic mechanism regional economic sustainable development. The eighth chapter on carbon dioxide emissions as the substitute variables of environmental pollution, measure the area of China’s energy consumption carbon footprint; in order to measure the labor density, concentration of human capital and material capital, business location and spatial autocorrelation; the quality of the environment as endogenous factors and the introduction of production function and utility function, the use of dynamic optimization as the basic analysis tool, the optimal solution of the steady growth; construct local spillovers model, the demand analysis of related elements of spatial agglomeration, economies of scale and external overflow pollution, congestion mechanism of external non economic effect on the coordinated development of regional economy; the formation of constructing game model of regional economic cooperation and regional economic cooperation utility allocation problem analysis and the cooperation mechanism. The main contents and conclusions of the eighth chapter are as follows: ①agglomeration, regional economic development and environmental the interaction mechanism of carbon dioxide emissions as alternative variables to measure the carbon footprint of the environmental pollution, the area of China’s energy consumption. In order to measure the density of agglomeration of labor, physical capital and human capital, business location and spatial auto correlation, labor, physical capital and human capital are highly concentrated, professional human capital the maximum degree of material, the profit of capital and human capital spillover effects make it easy to show a significant positive correlation, showing the distribution pattern of high or low concentration space. Using Divisia index decomposition method, analyzes the scale effect of regional economic growth to environmental pol-



lution emissions, the effect of technical progress, the effect of regional industrial structure and spatial structure. The results show that the scale effect and the regional industrial structure is not reasonable for the main cause of environmental pollution, regional space the structure effect to adverse effects on the improvement of environmental quality; technology effect on the improvement of environmental quality plays a positive role in promoting. ②On the sustainable development of Regional Economy Endogenous Mechanism under environmental constraints agglomeration. The impact on regional economic development factors using panel fixed effect model for empirical analysis. The results show that capital deepen significantly promote the improvement of labor productivity; the existence of “inverted U” relationship between physical capital agglomeration and regional economic growth, physical capital agglomeration, hindered the improvement of labor productivity; human capital accumulation has significant effect on labor productivity; has a negative effect on the efficiency of environmental invalid labor productivity; only human capital agglomeration has absorption effect on regional innovation, regional innovation capability indirectly through its effect on promoting the development of regional economy that physical capital agglomeration brought by capital deepening and not effect on regional innovation. ③The mechanism and the coordinated development of regional economy and environment. Based on the advantages of regional economic cooperation, we construct a dynamic game model of regional economic cooperation of the analysis of regional economic cooperation of utility and the allocation of the formation of the cooperation mechanism. We found that the local governments participate in the cooperation to bring economic and environmental utility increment loss to the alliance, the difference between the two is the net effect of participation and cooperation of the local government to bring the alliance, according to the proportion of regional economic cooperation in the utility.

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