



Industrial land price and its impact on urban growth: A Chinese case study

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ABSTRACT

China is experiencing rapid progress in industrialization, with its own rationale toward industrial land development based on a deliberate change from an extensive to intensive form of urban land use. One result has been concerted attempts by local government to attract foreign investment by a low industrial land price strategy, which has resulted in a disproportionately large amount of industrial land within the total urban land use structure at the expense of the urban sprawl of many cities. This paper first examines "Comparable Benchmark Price as Residential land use" (CBPR) as the theoretical basis of the low industrial land price phenomenon. Empirical findings are presented from a case study based on data from Jinyun County, China. These data are analyzed to reveal the rationale of industrial land price from 2000 to 2010 concerning the CBPR model. We then explore the causes of low industrial land prices in the form of a "Centipede Game Model", involving two neighborhood regions as "major players" to make a set of moves (or strategies). When one of the players unilaterally reduces the land price to attract investment with the aim to maximize profits arising from the revenues generated from foreign investment and land premiums, a two-player price war begins in the form of a dynamic game, the effect of which is to produce a downward spiral of prices. In this context, the paradox of maximizing profits for each of the two players are not accomplished due to the inter-regional competition of attracted investment leading to a lose-lose situation for both sides' in competing for land premium revenues. A short-term solution to the problem is offered involving the establishment of inter-regional cooperative partnerships. For the longer term, however, a comprehensive reform of the local financial system, more adroit regional planning and an improved means of evaluating government performance is needed to ensure the government's role in securing public goods is not abandoned in favor of one solely concerned with revenue generation.

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Introduction

Since the 1990s, China has gradually established and improved its socialist market economy, boosting its progress in industrialization and urbanization. As a result, a large number of urban construction and industrial parks have taken the place of what was formerly cultivated land, increasing China's grain supply security risks and reliance on imported food products. At the same time, international food reserves have fallen to their lowest levels in

history, raising questions over the ability of the international grain market to meet future Chinese food deficits.

This situation was recognized as long ago as 1995 in the World Watch Institute's report *Who will feed China?* (Brown, 1995), alerting the Chinese nation to the importance of protecting their cultivated land (Wu et al., 2002). Subsequently, in 1997, the CPC Central Committee and State Council issued its *To further strengthening land management to protect arable land effectively*, authorizing the establishment of a comprehensive inventory of all types of construction land in existence since 1991. This was followed in 1998 by modifications to *The Land Administration Law of People's Republic of China*, which provided land use control and strictly limited the conversion of agricultural land to non-agricultural land. These policies should have deterred the replacement of agricultural land by construction land. However, according to the 2003 national industrial park inventory, the number of industrial parks was 5658 with a planning area of 36,000 km², which exceeds the total China urban

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工业用地价格及其对城市增长的影响: 中国案例研究

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中国正在经历工业化的快速发展, 其工业用地开发的理论基础是城市土地利用从粗放型向集约型的刻意转变。一个结果是, 地方政府通过低工业用地价格战略共同努力吸引外国投资, 这导致城市土地利用总体结构中的工业用地数量过多, 而许多城市的城市扩张则是以牺牲为代价的。本文首先考察了“住宅用地可比基准价格”(CBPR)作为低工业用地价格现象的理论基础。实证结果来自基于中国缙云县数据的案例研究。对这些数据进行分析, 以揭示2000年至2010年关于CBPR模型的工业用地价格的基本原理。然后, 我们以“蜈蚣博弈模型”的形式探讨了工业用地价格低的原因, 将两个相邻区域作为“主要参与者”参与其中, 以采取一系列行动(或策略)。当其中一方单方面降低土地价格以吸引投资, 目的是最大限度地提高外国投资和土地溢价产生的收入所带来的利润时, 一场两方价格战以动态博弈的形式开始, 其效果是产生价格的螺旋式下降。在这种情况下, 由于吸引投资的区域间竞争导致双方在争夺土地溢价收入时出现双输的局面, 两个参与者的利润最大化悖论没有实现。该问题的短期解决办法是建立区域间合作伙伴关系。然而, 从长远来看, 需要对地方金融体系进行全面改革, 更灵活的区域规划和改进的政府绩效评估手段, 以确保政府在确保公共产品安全方面的作用不会被放弃, 而只关注创收。

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简介

20世纪90年代以来, 中国逐步建立和完善了社会主义市场经济体制, 推动了工业化和城镇化进程。因此, 大量城市建设和工业园区取代了原来的耕地, 增加了中国粮食供应安全风险和对进口食品的依赖。与此同时, 国际粮食储备已降至世界最低水平

这让人们质疑国际粮食市场是否有能力应对中国未来的粮食短缺。

早在1995, 世界观察研究所(World Watch Institute)的报告就认识到了这种情况: 谁来养活中国?(Brown, 1995), 提醒中华民族保护耕地的重要性(Wu等人, 2002)。随后, 在1997, 中共中央和国务院发布了《关于进一步加强土地管理, 有效保护耕地的决定》, 授权对1991. 以来存在的各类建设用地进行全面清查。随后在1998, 对《中华人民共和国土地管理法》进行了修改, 该法规定了土地使用控制, 并严格限制农业用地转为非农业用地。这些政策本应阻止建设用地取代农业用地。然而, 根据2003. 的国家印度河- 园区试点清查, 工业园区数量为5658个, 规划面积3.6万平方公里², 超过中国城市总体规模

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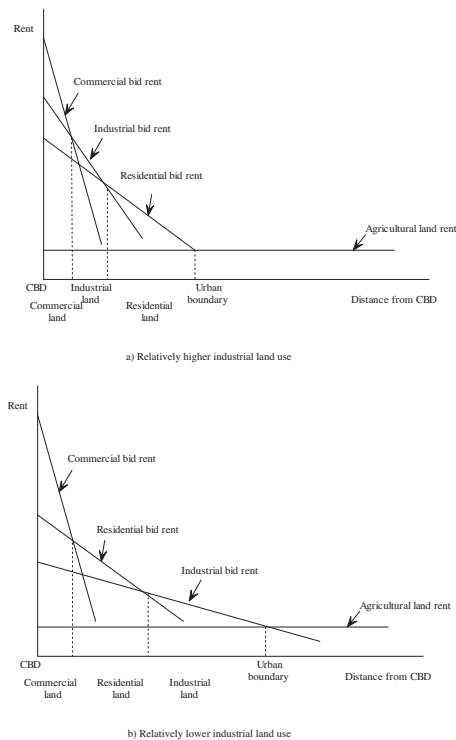


Fig. 1. Influence of different the industrial land bid-rent curve slopes on urban boundaries and urban spatial structure.

construction land area at that time (Chen, 2004). It is clear, therefore, that the problems of industrial-agricultural land imbalance as well as the extensive industrial land use are far from resolved as yet (Hong, 2007).

Land prices are closely related to urban growth, particularly in China, which acts as a 'world factory' and requires much industrial land (Zhang, 2006). Industrial land prices are therefore considered the decisive driving force behind urban growth. According to the classic mono-centric theory of urban economics, employment centers are usually situated in the city center (CBD). By using different types of land bid-rent curve analyses, the urban spatial structure model (O'Sullivan, 2000) was established (as shown in Fig. 1). Clearly, different forms of bid-rent curves (for commercial land, residential land, industrial land, etc.) affect urban spatial structure and city size. Assuming the bid-rent curves for commercial land and residential land remain unchanged, it is obvious that changes in the slope of the industrial land bid-rent curve will have a significant impact. When the prices of industrial land tracts are relatively high, the slope of the bid-rent curve is greater and the spatial distribution of industrial land is located between commercial and residential sites. At the same time, the land structure within the city boundary is determined by the slope of bid-rent curve of

residential land (Fig. 1a). On the other hand, when industrial land prices are relatively low, the bid-rent curve slope is flat and the spatial distribution of industrial land is located outside of residential sites. In this case, the land structure within the city boundary is determined by the slope of the bid-rent curve of industrial land (Fig. 1b). That is to say, theoretically, low industrial land prices (Fig. 1b) would be the cause of the phenomenon of urban sprawl in China.

Therefore, two basic hypotheses are proposed in this paper: (1) the policy of low industrial land prices lead to too great a proportion of industrial land within the overall urban land use structure, which therefore indicates that the ever-increasing amount of industrial land is an important driving force behind China's urban growth; and (2) the cause of low industrial land prices is the intensity of inter-regional competition in attempting to attract foreign investment, resulting in the urban sprawl of many cities, as shown in Fig. 1b.

Industrial land use policy in China

Review of industrial land allocation policies

Since the founding of the new PRC in 1949, China's industrial land allocation policies have gone through many stages, during which the role of market has varied.

Stage I: 1949–1954, state ownership of industrial land with low fees or rent

In the early period, the co-existence of state-owned and private land prevailed. Private land could be traded, rented, etc. Later, the government transferred most of urban land to state-owned land, typically by administrative take-over, confiscation, redemption and legal announcement. The state ownership of land was therefore gradually established. During this period, individuals and institutions had to pay rent or fees, controlled and regulated by the government, in order to use the land. Government action therefore gradually replaced the market in allocating industrial land at this stage.

Stage II: 1955–1978, government assignment of industrial land use

In 1954, the rent and fees for land use were canceled at the behest of the Financial Secretary and Department of Interior. Payments from individuals and institutions were no longer needed, lands for construction were allocated according to the overall land resource plan, and no land beyond these plans could be used. As a result, the land no longer constituted merchandise and the land market disappeared.

Stage III: 1979–1991, co-existence of government assigned and paid use of industrial land

Since 1979, with the reform of rural land use, farmers possessed title to long-term use rights though the land remained collectively owned. This greatly stimulated China's agricultural productivity. At the same time, with the continuous development of township enterprises, the economy started to boom, which prompted urban industrial land use management into a reform agenda in the 1980s. In 1987, for the first time, land in the Shenzhen Special Economic Zone was transferred through grant by negotiation and auction (Zhu, 1994). In the same year, with the State Council's proposal for the transferability of land use rights in the free market, pilot reform tests were further conducted at Fuzhou, Haikou, Guangzhou, Xiamen, Shanghai and Tianjin.

Stage IV: 1992–now, exploration development of industrial land

In 1992, the establishment of a socialist market economy status by the central government was formally determined. Urban

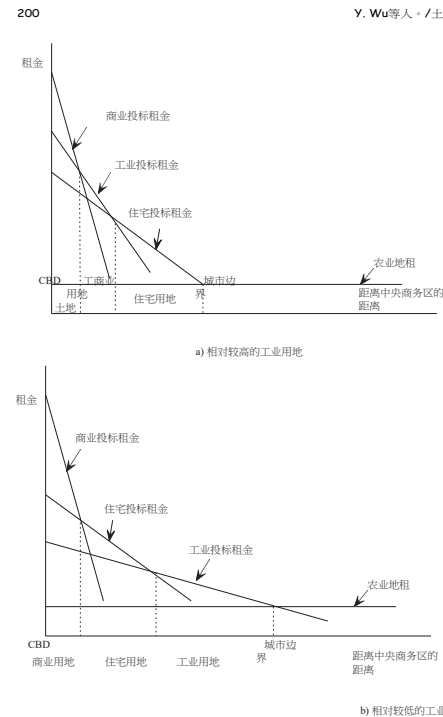


图1. 不同的工业用地招租曲线斜率对城市边界和城市空间结构的影响。

当时的建设用地面积 (陈, 2004)。因此, 很明显, 工农业用地不平衡以及工业用地广泛使用的问题远未得到解决 (Hong, 2007)。

土地价格与城市增长密切相关, 尤其是在中国, 它作为一个“世界工厂”, 需要大量工业用地 (张, 2006)。因此, 工业用地价格被认为是城市增长的决定性驱动力。根据经典的城市经济学单中心理论, 就业中心通常位于城市中心区 (CBD)。通过使用不同类型的土地买卖曲线分析, 建立了城市空间结构模型 (O'Sullivan, 2000) (如图1所示)。显然, 不同形式的招租曲线 (商业用地、住宅用地、工业用地等) 会影响城市空间结构和城市规模。假设商业用地和住宅用地的招租曲线保持不变, 很明显, 工业用地招租曲线斜率的变化将产生重大影响。当工业用地的价格相对较高时, 招租曲线的斜率较大, 工业用地的空间分布位于商业用地和住宅用地之间。同时, 城市边界内的土地结构由城市的投标-租金曲线斜率决定

住宅用地 (图1a)。另一方面, 当工业用地价格相对较低时, 招租曲线斜率是平坦的, 工业用地的空间分布位于住宅用地之外。在这种情况下, 城市边界内的土地结构由工业用地的招租曲线斜率决定 (图1b)。也就是说, 理论上, 低工业用地价格 (图1b) 将是中国城市扩张现象的原因。

因此, 本文提出了两个基本假设: (1) 低工业用地价格政策导致工业用地在整个城市土地利用结构中所占比例过大, 这表明不断增加的工业用地数量是中国经济增长的重要驱动力; 和 (2) 工业用地价格低的原因是相互作用的强度-吸引外国投资的区域竞争,

导致许多城市的城市蔓延, 如图1b所示。

中国的工业用地政策

工业用地分配政策检讨

自1949年新中国成立以来, 中国的工业用地分配政策经历了多个阶段, 其间市场的作用有所不同。

第一阶段: 1949年至1954年, 低收费或低租金的工业用地国有化

早期, 国有土地和私有土地并存。私人土地可以交易、出租等。之后, 政府将大部分城市土地转让给国有土地, 通常通过行政接管、没收、赎回和法律公告。因此, 土地的国家所有权逐渐确立。在此期间, 个人和机构必须支付租金或费用, 由政府控制和监管, 以便使用土地。因此, 在现阶段, 政府行为逐渐取代了市场对工业用地的分配。

第二阶段: 1955年至1978年, 政府转让工业用地

1954年, 在财政部和内政部的要求下, 取消了土地使用的租金和费用。不再需要个人和机构支付费用, 根据土地资源总体规划分配建设用地, 不得使用这些规划以外的土地。结果, 土地不再构成商品, 土地市场消失。

第三阶段: 1979年至1991年, 工业用地的政府出让和有偿使用并存

1979年以来, 随着农村土地使用制度的改革, 农民拥有长期使用权, 但土地仍属于集体所有。这极大地刺激了中国的农业生产。与此同时, 随着乡镇企业的不断发展, 经济开始蓬勃发展, 这促使城市工业用地管理在20世纪80年代进入改革议程。1987年, 深圳经济特区的土地首次通过协商和拍卖的方式出让 (朱立军, 1994年)。同年, 随着国务院关于土地使用权在自由市场中可转让性的建议, 福州、海口、广州、厦门、上海和天津进一步进行了改革试点。

第四阶段: 1992年至今, 工业用地的勘探开发

1992年, 中央政府正式确立了社会主义市场经济地位。城市的

Table 1
Planning area of industrial parks in Zhejiang Province prefecture-level cities.

Prefecture-level cities	Built-up area of city center	Planning area of the industrial park within the prefecture city	Ratio of planning area of industrial park to built-up area	Notes
Hangzhou	344.48	164.36	47.7%	8 Industrial Parks including Hangzhou Hi-tech Industrial Development Zone
Ningbo	221.40	230.70	104.2%	8 Industrial Parks including Ningbo Economic and Technological Development Zone
Wenzhou	153.00	76.85	50.2%	6 Industrial Parks including Wenzhou Economic and Technological Development Zone
Jiaxing	78.50	94.65	120.6%	4 Industrial Parks including Jiaxing, Export Processing Zone at Zhejiang
Huzhou	71.70	86.07	120.0%	2 Industrial Parks including Huzhou Economic and Technological Development Zone
Shaoxing	90.10	75.76	84.1%	2 Industrial Parks including Shaoxing Economic and Technological Development Zone
Jinhua	68.79	118.04	171.6%	2 Industrial Parks including Jinhua Economic and Technological Development Zone
Quzhou	44.70	41.74	93.4%	2 Industrial Parks including Quzhou Economic and Technological Development Zone
Zhoushan	49.17	14.82	30.1%	3 Industrial Parks including Zhoushan Economic and Technological Development Zone
Taizhou	113.87	143.89	126.4%	5 Industrial Parks including Taizhou Economic and Technological Development Zone
Lishui	26.00	20.05	77.1%	Lishui Economic Development Zone
Total	1261.71	1066.93	84.6%	43 Industrial Parks

Data source, Zhejiang Provincial Office of Construction, Yearbook of Zhejiang urban and rural development at 2008; Amended according to the Inventory data of industrial park, Zhejiang Provincial Office of Land and Resources at 2005.

construction in China, particularly that in industrial parks, mushroomed in various places. In order to curb the momentum of cultivated/agricultural land occupied by rapid urbanization and industrialization the *Land Management Law* was amended in 1998 in order to establish improved land use control.

Policy for industrial parks

In 2001, the industrial land use right transfer was introduced to terminate the non-competitive *Agreement-based assignment of the right to state-owned land use* in favor of the competitive *tender, bid and auction approach to state-owned land use* (the so-called “zhao pai gua”). Since 2006, the Ministry of Land and Resources has issued its *Minimum price standards for the transfer of land for industrial use and Industrial land control targets*. This led to China’s “world factory” role, with the dramatically expanding development of its large-sized industrial parks. In Zhejiang Province, for example, the number of estimated planning development zones reached 754 in 2005 while the actual number of development zones approved was only 80.

The planning areas of industrial parks in Zhejiang Province’s 11 prefecture-level cities are summarized in Table 1. As shown, the total area of the parks is around 1067 ha, in contrast with a total central urban built-up area of only 1262 ha. Likewise, for the individual urban centers of Ningbo, Jiaxing, Huzhou, Jinhua and Taizhou City, the total area of industrial parks exceeds that of total urban built-up area.

Industrial land use and urban growth management: key literature

The two major issues regarding industry development and the impact on industrial land concern employment and pollution. This is reflected in the two major topics – “Location” and “Zoning” – found largely in the early literature (Weber, 1929; Alonso, 1964; Miller and de Roo, 1997). There, an obvious difference in research focus is apparent between developing and developed countries. With developed countries, the research is not focused on increased industrial land, but on sustainable development. As Ziegler (2009) points out, a metropolitan sustainable development governing framework for growth management in the twenty-first century is essential for a sustainable future.

A particularly important recent Western study by Liu et al. (2007) couples human and natural systems to reveal new and complex patterns and processes. Their synthesis of six case studies from around the world shows that such couplings vary across space,

time, and organizational units. The nonlinear dynamics involved, with thresholds, reciprocal feedback loops, time lags, resilience, heterogeneity and surprises are also demonstrated, with couplings having legacy effects on present conditions and future possibilities. In Ziegler’s (2009) case, this includes both the provision of higher-density urban centers and transit-oriented development centers, and a change in public attitude away from “not in my back yard” thinking. Using 1998–2003 panel data from 406 Florida cities, Lubell et al. (2009) conducted an empirical analysis to identify important interaction effects between the structure of city executive branch institutions and interest group variables. Institutional structure helps determine which interest groups’ preferences are reflected in local land-use changes and development patterns. The resulting patterns suggest a “sustainability paradox”, in which richer, environmental interests pursue the preservation of environmental amenities while at the same time accelerating the number of residential units built in a community.

With developing countries, the research focus emphasizes urban growth management in the process of urbanization in addition to industrialization. Some scholars apply the concept of ‘urban growth boundaries (UGB)’, already in use in the early period of developed countries, to urban growth research in developing countries. UGB is a regulatory measure used by local government for delineating the limits of urban growth over a period of time. Land within the UGB allows urban development, while the land outside remains primarily non-urban. Recently, UGB management rules have been extensively applied in the urban land-use management discipline in developing countries. For example, Bhatta (2009) introduced the concept model ‘ideal urban radial proximity’ (IURP), involving the increasing popularity, urban vegetation, water bodies and other important non-urban areas within the inner city space to designate a spatial UGB using geo-informatics in a digital environment. This conceptual model has been applied in the Kolkata urban agglomeration in India. In China, Feng et al. (2010) put forward the concept of Urban Construction Boundary (UCB). Three indicators on boundary control were proposed, including the effectiveness of boundary containment, land inventory sufficiency and illegal adjacent development to the UCB. It is found that the effectiveness of urban construction boundary containment is not good and it is not binding well. There is still much room for improvement in the future. Bae and Sellers (2007), on the other hand, explore the politics of urban growth in a transitional society in Korea. Here, a multilevel analysis approach is established to show that the transformations in Korea as a late industrializer, late democratizer and late adopter of urban policy have helped to consolidate more restricted policies on urban growth than in

表1

浙江省地级市工业园区规划面积。

地级城市	市中心建成区	地级市工业园区规划面积	工业园区规划面积与建成区面积之比	注释
杭州	344.48	164.36	47.7%	杭州高新技术产业开发区等8个工业园区
宁波	221.40	230.70	104.2%	宁波经济技术开发区等8个工业园区
温州	153.00	76.85	50.2%	温州经济技术开发区等6个工业园区
嘉兴	78.50	94.65	120.6%	嘉兴、浙江出口加工区等4个工业园区
湖州	71.70	86.07	120.0%	湖州经济技术开发区等2个工业园区
绍兴	90.10	75.76	84.1%	绍兴经济技术开发区等2个工业园区
金华	68.79	118.04	171.6%	金华经济技术开发区等2个工业园区
衢州	44.70	41.74	93.4%	衢州经济技术开发区等2个工业园区
舟山	49.17	14.82	30.1%	舟山经济技术开发区等3个工业园区
台州市	113.87	143.89	126.4%	台州经济技术开发区等5个工业园区
Lishui	26.00	20.05	77.1%	丽水经济开发区
总计	1261.71	1066.93	84.6%	43个工业园区

数据来源：浙江省建设厅，《2008年浙江省城乡发展年鉴》；根据浙江省国土资源厅2005年工业园区清查数据修订。

中国的建筑业，尤其是工业园区的建筑业，在各地如雨后春笋般涌现。为了遏制快速城市化和工业化占用耕地/农业用地的势头，1998年修订了《土地管理法》，以建立更好的土地使用控制。

工业园政策

2001年，引入了工业用地使用权转让，以终止基于非竞争性协议的国有土地使用权转让，支持国有土地使用权的竞争性招标、投标和拍卖方式（所谓的“招拍挂”）。自2006年以来，国土资源部发布了工业用地出让最低价格标准和工业用地控制目标。这导致了中国的“世界工厂”角色，其大型工业园区的发展急剧扩大。以浙江省为例，2005年，预计的规划开发区数量达到754个，而实际批准的开发区数量只有80个。

浙江省11个地级市工业园区规划面积汇总表1。如图所示，公园的总面积约为1067公顷，而中心城区的总建筑面积仅为1262公顷。同样，就宁波、嘉兴、湖州、金华和台州市的各个城市中心而言，工业园区的总面积超过了城市建成区的总面积。

工业用地使用和城市增长管理：关键文献

关于工业发展和对工业用地的影响的两个主要问题涉及就业和污染。这反映在两大主题中——“位置”和“分区”——主要见于早期文献（韦伯，1929年；阿隆索，1964年；米勒和德鲁，1997年）。在那里，发展中国家和发达国家在研究重点上存在明显差异。在发达国家，研究的重点不是增加工业用地，而是可持续发展。正如齐格勒（2009）所指出的那样，21世纪增长管理的大都市可持续发展治理框架对于可持续未来至关重要。

Liu等人（2007年）最近进行的一项特别重要的西方研究将人类和自然系统结合起来，以揭示新的复杂模式和过程。他们对来自世界各地的六个案例研究的综合表明，这种耦合在空间上各不相同，

时间和组织单位。还展示了所涉及的非线性动力学，包括阈值、相互反馈回路、时滞、弹性、异质性和意外，以及对当前条件和未来可能性产生遗留影响的耦合。在齐格勒（2009）的案例中，这包括提供更高密度的城市中心和以交通为导向的发展中心，以及改变公众对“不在我的后院”思维的态度。卢贝尔等人（2009）利用佛罗里达州406个城市1998–2003年的面板数据进行了实证分析，以确定城市行政部门机构结构和利益集团变量之间的重要互动效应。制度结构有助于确定哪些利益集团的偏好反映在当地土地使用变化和发展模式中。由此产生的模式表明了一种“可持续性悖论”，在这种悖论中，更富有的环境利益集团追求保护环境设施，同时加快社区内住宅单元的数量。

在发展中国家，研究重点除了工业化外，还强调城市化过程中的城市增长管理。一些学者将发达国家早期已经使用的“城市增长边界”（UGB）概念应用于发展中国家的城市增长研究。UGB是地方政府用于划定一段时间内城市增长限制的监管措施。UGB内的土地允许城市发展，而UGB外的土地主要是非城市土地。最近，UGB管理规则在发展中国家城市土地使用管理学科中得到了广泛应用。例如，Bhatta（2009）引入了概念模型“理想城市径向接近度”（Iurban radial Proximity, IURP），涉及日益普及的城市植被、水体和其他重要的城市内部区域，以在数字环境中使用地理信息学指定空间UGB。该概念模型已应用于印度加尔各答城市群。在中国，Feng等人（2010）提出了城市建设边界（UCB）的概念。提出了关于边界控制的三个指标，包括边界控制的有效性、土地存量充足性和UCB的非法相邻开发。研究发现，城市建设边界遏制的有效性不好，约束性不强。未来仍有很大的改进空间。另一方面，Bae和Sellers（2007）探讨了韩国转型社会中城市发展的政治。本文建立了一种多层次分析方法，以表明韩国作为城市政策的后工业化者、后民主化者和后采纳者的转变，有助于巩固比过去更受限制的城市增长政策。

the USA and much of Europe. The research findings further highlight the dynamics involved at global, national and local levels to explain the similarities and differences in the growth politics of a transitional society such as Korea with those of older industrialized democracies. Similarly, Zhao et al. (2009) investigated the decentralized-concentration strategy, one of the most important metropolitan growth management initiatives in Beijing since the 1990s, to better understand the effectiveness of growth management in a transformational context. The results suggest that the aims of municipal growth management to concentrate developments in the urban fringe have been partly achieved through actual local development; while some unexpected and illegal local developments outside the planned areas have been counterproductive. The performance of present growth management is also being challenged by new trends in political decentralization and changed local fiscal responsibilities.

With the rapid process of urbanization and industrialization, there have been many studies of industrial land use in China, with the intensive use of industrial land becoming a major focus. For example, Wu (2007) considers the critical determinants of extensive land use to be the very low industrial land use prices occurring because of intense competition among regions to attract foreign investment. Lu et al. (2006) argue that industrial land is the main driving force behind urban land expansion and, as a result, controlling and guiding increased industrial land use is the key to achieving its sustainability. Along these lines, Jia et al. (2010) holds that it is necessary for China to adopt industrial land planning, standards, preliminary review as well as monitoring overall industrial land intensive use. In addition, an analysis of industrial land use in Ningbo indicates the local economic development level to be an important factor affecting the intensive use of industrial land (Li et al., 2008). Gu et al. (2009) believe that selecting different industries for different areas will help promote overall intensive land use planning.

In comparison with the literature relating to developing countries, studies of industrial land use in most of developed countries focus on the risks in industrial land redevelopment, such as those involved in the development and utilization of brownfield land (Sigman, 2010; Adams et al., 2010). Zhu (2000) points out that industrial land use policy often changes due to industrial economic development needs followed by rapid global economic development. Meanwhile, Wong and Tang (2005) indicate that a great deal of vacant land is found in the Economic and Technological Development Zone of China due to 'development zone fever', which has resulted in both the waste of valuable land resources and inefficient land use.

In short, most studies have been of industrial land use in addition to urban growth management from the perspective of planning, while very little systematic research has been conducted in terms of the combination of market and planning strategies. This paper, therefore, aims to explicate the driving forces as well as causes behind the burgeoning industrial land in China from the perspective of land transfer prices, as a contribution to the regulation of urban growth in developing countries in general. The data is collected from the local land transfer database in a county region of Zhejiang Province.

The case of Jinyun County

Jinyan is a Chinese county – an administrative unit of very important historical and realistic significance in China as reflected in the mantra *Junxian zhi, Tianxia an* (if the counties are well managed, the whole country will be peaceful and prosperous). In China's administrative structure, counties are ranked below prefecture-level cities, with each prefecture-level city having jurisdiction over

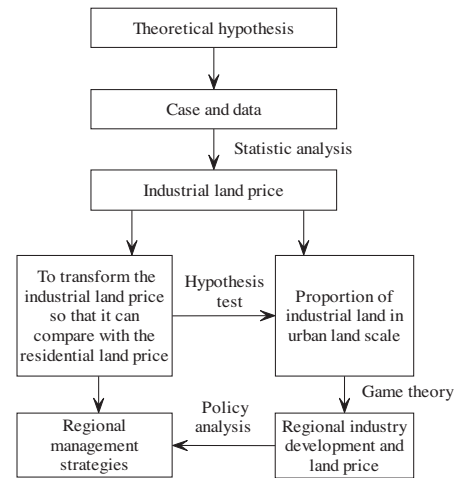


Fig. 2. Map of research methodology.

a number of counties. A county with a larger population or economic scale is termed a 'county-level city'. For example, Shenzhen is ranked as "a prefecture-level city", while Yiwu (renowned for its small commodity trading) is classified as "county-level city". There are a total of 285 prefecture-level cities, 368 county-level cities and 1570 counties (MCA, 2012). The extreme importance of the role that the county unit plays in the national power structure and development strategy has provided it with independent rights in administration, judicial, financial and other sectors, and the exercise of land use right transfers (Chen et al., 2006).

In this paper, industrial land use prices at the County level are analyzed to understand the relationship between the selling prices and proportion of urban land involved, and to interpret the effects of increased amounts of industrial land on urban growth. A dynamic game theory approach is then used to further assess the influence of low industrial land prices on regional industry development. Fig. 2 illustrates what is involved.

Case area

The district analyzed in this study, Jinyun County in Zhejiang Province, is a typical County unit in China. It is located in Lishui City, covering an area of 1495 km² and with a population of 453,404 in 2010 (Fig. 3). At distance of 300 km from Shanghai, Jinyun County is a 'relatively developing region' in the south of Zhejiang Province. The year 2002 marked the opening of the highway from Jinyun County to Hangzhou, the capital of Zhejiang Province – greatly improving access to the County. According to the sixth Census data in China, the population of Jinyun County is 358,900. It is ranked 18th of the 36 administrative counties in Zhejiang Province, which makes it very representative of China's coastal regions. In 2010, the overall GDP of Jinyun was RMB \$10.78 billion, with the proportion of three major industrial sectors (agriculture, industry, and services) being "6:60:34" respectively.

美国 and 欧洲大部分地区。研究结果进一步强调了全球、国家和地方层面的动态，以解释韩国等转型社会的成长政治与旧工业化民主国家的成长政治的异同。同样，赵等人（2009）调查了分散集中战略，这是北京自20世纪90年代以来最重要的都市增长管理举措之一，以更好地理解转型背景下增长管理的有效性。结果表明，城市增长管理的目标集中在城市边缘地带，部分是通过当地的实际发展实现的；然而，在规划区域之外的一些意外和非法的地方发展却适得其反。当前增长管理的表现也受到政治权力下放和地方财政责任变化的新趋势的挑战。

随着城市化和工业化进程的加快，我国对工业用地的研究越来越多，工业用地的集约利用成为研究的重点。例如，Wu（2007）认为，大规模土地利用的关键决定因素是，由于区域间吸引外国投资的激烈竞争，工业用地价格非常低。Lu等人（2006年）认为，工业用地是城市用地扩张的主要驱动力，因此，控制和引导工业用地的增加是实现其可持续性的关键。按照这些思路，贾等人（2010）认为，中国有必要采用工业用地规划、标准、初步审查以及监测工业用地的总体集约利用。此外，对宁波市工业用地的分析表明，当地的经济水平是一个重要指标。

影响工业用地集约利用的重要因素（Li等人，2008年）。顾等人（2009）认为，为不同地区选择不同的产业将有助于促进土地集约利用总体规划。

与有关发展中国家的文献相比，大多数发达国家的工业用地使用研究侧重于工业用地再开发中的风险，例如涉及棕地土地开发和利用的风险（Sigman，2010；Adams et al.，2010）。朱（2000）指出，随着全球经济的快速发展，工业用地政策往往会因工业经济发展的需要而发生变化。同时，Wong和Tang（2005）指出，由于“开发区热”，中国经济技术开发区发现了大量闲置土地，这既造成了宝贵土地资源的浪费，也造成了土地利用的不足。

总之，大多数研究都是从规划的角度对城市增长管理的补充，而在市场和规划策略的结合方面进行的系统研究很少。因此，本文旨在从土地转让价格的角度阐述中国新兴工业用地背后的驱动力和原因，为发展中国家的城市增长监管做出贡献。数据来自浙江省某县的土地流转数据库。

缙云县案例

金岩是中国的一个县——正如天下安君贤之咒所反映的那样，金岩是一个在中国具有非常重要历史和现实意义的行政单位（如果这些县都是人，整个国家就会和平繁荣）。在中国的行政结构中，县的级别低于地级市，每个地级市都有管辖权。

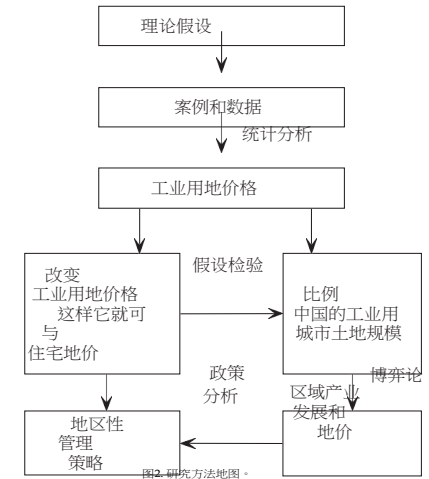


图2. 研究方法地图。

许多县。人口或经济规模较大的县称为“县级市”。例如，深圳被列为“地级市”，而义乌（以小商品贸易闻名）被列为“县级市”。县单位在国家权力结构和发展战略中发挥的极端重要作用，为其在行政、司法、金融和其他部门以及土地使用权转让的行使提供了独立的权利（Chen等人，2006年）。

本文对县级工业用地使用价格进行了分析，以了解销售价格与城市土地所占比例之间的关系，并解释工业用地数量增加对城市增长的影响。一个动态博弈论的方法是，让我们了解低工业用地价格对区域工业发展的影响。图2说明了所涉及的内容。

缙云县

本研究分析的浙江省缙云县是中国一个典型的县域单位。位于丽水市，面积1495. 里²，2010. 人口453404. （图3）。缙云县距离上海300. 里，是浙江省南部的一个“相对发达地区”。2002.，从缙云县到浙江省省会杭州的高速公路开通，大大改善了通往该县的道路。根据中国第六次人口普查数据，缙云县人口为358900.。它在浙江省36. 行政县中排名第18.，这使它非常具有中国沿海地区的代表性。2010.，缙云市GDP总量为107. 8. 元，三大工业部门（农业、工业和服务业）的比例分别为“6. 60. 34.。 ”

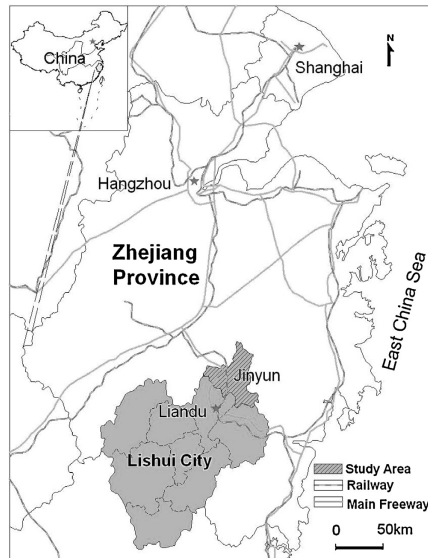


Fig. 3. Location of study area, Jinyun County.

Comparative analysis of industrial land prices and residential land prices

As early as the Ninth Five-Year Plan period (2001–2005), Wen Jiabao, the Premier of the Chinese State Council, announced its intention to move the country's economic growth from an extensive to intensive mode although, as yet, the extensive mode of growth still dominates (Wen, 2005). In terms of land use, the supply of industrial land use is particularly acute (Hong, 2007). As the most critical determinant of industrial land use availability are very low industrial land transfer prices, the Ministry of Land and Resources issued its *Minimum price standards for the transfer of land for industrial use*, followed by various local implementation rules in different provinces. As is shown by local survey data, however, the very low industrial land prices have prevented the desired fundamental change of urban growth from extensive use to intensive use. During the period 2000–2010, 364 tracts of industrial land with a mean value of 123 yuan/m² (106 yuan/m², 634 yuan/m² and 25 yuan/m² for the median, highest and lowest prices respectively), were transferred by bid and agreement (Fig. 4).

However, industrial land prices were relatively lower than the sale prices of residential land during the same period, with the average bid price of residential land during 2000–2010 being 3816 yuan/m² – increasing after 2007 to 4865 yuan/m².

As the policies for industrial land use and residential land use are different, equivalent values need to be established in line with the relevant parameters of *Industrial land control targets*. On one hand, the regulations require that the proportion of the land area of administrative office and living facilities cannot exceed 7% of the overall amount of project land. In fact, the administrative office and living facilities can be used as residential houses for workers, and so the land area involved is equivalent to residential land. On the other hand, the maximum term of residential land use is 70 years

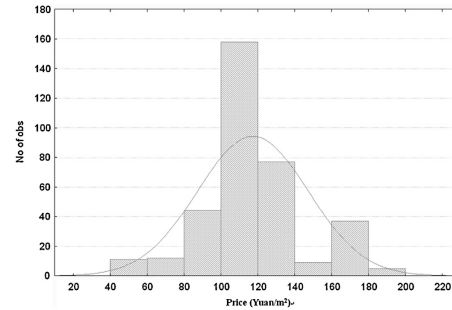


Fig. 4. Industrial land prices in Jinyun from 2000 to 2010.

and that of industrial land use is 50 years. According to current rates, the interest rate of bank loans with a maturity of 5 years is 5.94%, while the conversion ratio of industrial land to residential land is 0.9620. This is calculated by the Capitalized approach on condition that the term of 70 years is equivalent to 98.3% of the indefinite and the term of 50 years is equivalent to 94.6% of the indefinite. To sum up, the comparison of benchmark relations on characteristics and conversion price between industrial and residential land is shown in Table 2.

In line with Table 2, a theoretical model named the “Comparable benchmark price as residential land use” (CBPR) was therefore established for use as a method of converting industrial land prices to residential land prices in Jinyun from 2000 to 2010, where

$$CBPR = IP/RALO/CRIR = 123/7\%/0.9620 = 1826 \text{ (yuan/m}^2\text{)}$$

where IP denotes the “Industrial land transfer price”, RALO the “the ratio of land area of administrative office and living facilities to the overall land area” and CRIR the “conversion ratio of industrial land to residential land”.

In this study, the CBPR is a type of shadow price model. In the model, the total industrial land transfer fee is completely projected onto land for the administrative office and living facilities (7% of overall industrial project land) in order to gain the CBPR. In fact, the CBPR is comparable with the residential land transfer price, so that the land area of administrative offices and living facilities can be used as residential houses for the workers, which is equivalent to residential land area. The comparative price of residential housing in Jinyun County is 1826 yuan/m², which is only 48% of the average price of open lease-out residential land at 3816 yuan/m² (Table 2). As the function of land area for administrative office and living facilities is similar to that for residential houses in suburban areas, the enterprises can obtain the land compensation fee providing 93% of the land is idle. Briefly, if 7% of the industrial land can be used as residential project development, it is inevitable for enterprises to acquire industrial land (not for sale), by which to develop the disguised form of residential project development (for sale). Similarly, the comparable residential price in Jinyun after 2007 was $177/7\%/0.962 = 2629$, which is 54% of the average price of residential land at 4865 yuan/m² (see Table 3).

According to the rule of substitutability between land and capital, rational enterprises choose a combination of factor proportions including largest land area and minimal funds when industrial land price is very low, and which will therefore lead to extensive land use. In this way, low industrial land prices produce a potential price advantage induced by the search for change of land use type, and which eventually leads to the loss of state assets. With the

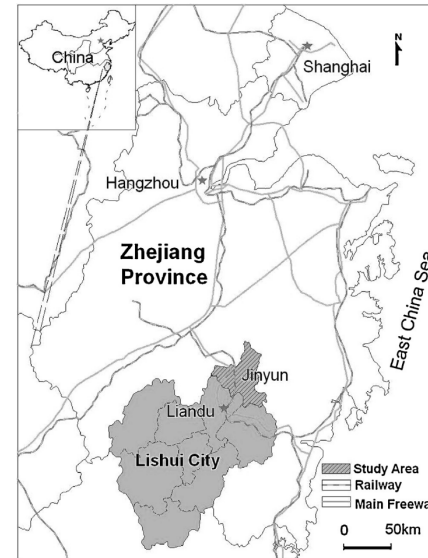


图3. 研究区域的位置，缙云县。

工业用地价格与住宅用地价格的比较分析

早在“九五”期间（2001年至2005年），中国国务院总理温家宝就宣布了将中国经济增长从粗放型模式转向集约型模式的意图，尽管到目前为止，粗放型增长模式仍然占主导地位（温家宝，2005年）。就土地利用而言，工业用地的供应尤为严重（Hong，2007）。由于工业用地可用性的最关键决定因素是非常低的工业用地转让价格，国土资源部发布了工业用地转让最低价格标准，随后在不同省份发布了各种地方实施细则。然而，正如当地调查数据所显示的那样，极低的工业用地价格阻止了城市增长从粗放型向集约型的根本转变。2000年至2010年期间，364块平均价值为123元/米²的工业用地（中间价106元/米²，最高价634元/米²和最低价25元/米²）通过投标和协议转让（图4）。

然而，工业用地价格相对低于同期住宅用地的销售价格，2000–2010年住宅用地的平均投标价格为3816元/米²，2007年后上升至4865元/米²。

由于工业用地和住宅用地的政策不同，需要根据工业用地控制目标的相关参数确定当量值。一方面，《条例》要求行政办公和生活设施用地面积的比例不得超过项目用地总量的7%。事实上，行政办公和生活设施可以用作工人的住宅，因此涉及的土地面积相当于住宅用地。另一方面，住宅用地的最长使用期限为70年

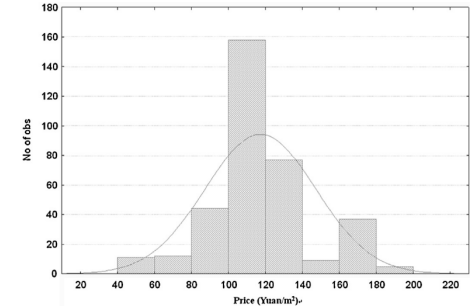


图4. 2000–2010年，缙云工业用地价格。

工业用地使用年限为50年。按现行利率计算，5年期银行贷款利率为5.94%，工业用地与住宅用地的转换率为0.9620。在70年的期限相当于不确定期限的98.3%，50年的期限相当于不确定期限的94.6%的情况下，采用资本化法计算。综上所述，工业用地和住宅用地的特征和转换价格基准关系对比如表2所示。

根据表2，建立了一个名为“住宅用地可比基准价格”（CBPR）的理论模型，作为2000年至2010年缙云市工业用地价格转换为住宅用地价格的方法，其中

$$CBPR = IP/RALO/CRIR = 123/7\%/0.9620 = 1826 \text{ (元/米}^2\text{)}$$

其中IP表示“工业用地转让价格”，RALO表示“行政办公和生活设施用地面积占总用地面积的比率”，CRIR表示“工业用地与住宅用地的转换比率”。

在本研究中，CBPR是一种影子价格模型。在该模型中，为了获得CBPR，工业用地转让费总额将完全计入行政办公和生活设施用地（占工业项目总用地的7%）。事实上，CBPR与住宅用地转让价格相当，因此行政办公和生活设施的土地面积可以用作工人的住宅，相当于住宅用地面积。缙云县住宅相对价格为1826元/米²，仅为公开出租住宅用地平均价格3816元/米²的48%（表2）。由于行政办公和生活设施用地的功能与郊区住宅用地类似，如果93%的土地闲置，企业可以获得土地补偿费。简言之，如果7%的工业用地可以用于住宅项目开发，企业就不必避免地要收购工业用地（不出售），从而开发变相的住宅项目开发（出售）。同样，2007年后缙云市可比住宅价格为177/7%/0.962 = 2629，为住宅用地平均价格4865元/米²的54%（见表3）。

根据土地与资本的替代性原则-

好未来，当工业用地价格非常低时，理性的企业会选择包括最大土地面积和最小资金在内的因素比例组合，从而导致土地的广泛使用。通过这种方式，低工业用地价格产生了一种潜在的价格优势，这种优势由寻找土地使用类型的变化引起，并最终导致国有资产流失。和

Table 2
Comparison of benchmark relations on characteristics and prices between industrial and residential land.

Land type	Ratio of land area of administrative office and living facilities to the overall land area (RALO)		Conversion ratio of industrial land to residential land (CRIR)		
	Use and characteristics	Ratio of Residential land use	Transferring time limit	In line with the current interest rate (5.94%), it is equivalent to an indefinite period as a percentage of the price	Ratio of industrial land to residential land is
Residential land	It could be planned as residential land	1	70	98.3%	1
Industrial land	7% of the land could be used as the administrative office and living facilities can be used as residential houses for workers, and so the land area involved is equivalent to residential land	0.070	50	94.6%	0.9620

Table 3
Comparison of transfer prices between industrial land and residential land.

Items	Residential land transfer price (yuan/m ²)	Industrial land		CBPR/residential land transfer price (%)
		Land transfer price (yuan/m ²)	CBPR (yuan/m ²)	
2000–2010	3816	123	1826	48
2007–2010	4865	177	2629	54

establishment of a low price policy of industrial land from 2000 to 2010, the industrial and warehousing land accounts for a significantly higher proportion of new built-up land of 864 ha in Jinyun. The new urban built-up land can be divided into four types, comprising public administration and infrastructure services land, industrial and warehousing land, residential land and commercial land. According to the 2000–2010 statistics, the amount of new urban land for the four types is 257.38, 480.81, 112.65 and 13.07 ha respectively, with industrial and warehousing land space accounting for 55.65% of the total (Fig. 5).

Corresponding with Jinyun's 2001–2020 comprehensive urban planning, industrial and warehousing land is 49.9 ha, accounting for 13.1% of the total urban land use area. According to the original comprehensive urban planning of Jinyun, new industrial and

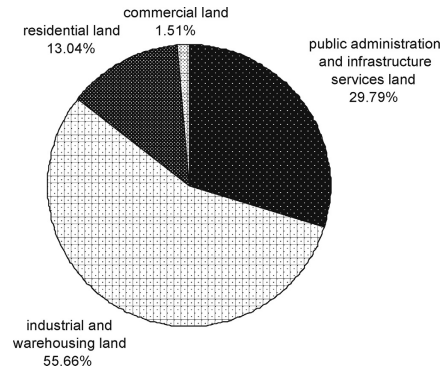


Fig. 5. Proportion of newly added construction land in Jinyun from 2000 to 2010.

warehousing land area was intended to be 93.0 ha, or 16.9% of the total urban land use area of 142.9 ha. In practice, however, new industrial and warehousing land area increased to 480.81 ha, accounting for 55.65% of total new construction land. Obviously, the original comprehensive urban planning was not well implemented, resulting in the proportion of industrial land area being too large and therefore preventing the intended change from extensive land use to intensive land use.

As shown above, the proportion of industrial and warehousing land is too high which is resulted by the relatively low industrial price (Fig. 5). The ever-increasing industrial land has therefore become the key driving force behind China's rapid urban growth. This phenomenon is echoed with the Hypothesis (1) in this study. The overwhelming proportion of industrial land in urban areas, that has occurred as a result of the low industrial land price policy, has made industrial land development the major driving force of urban growth in China.

Centipede game model: causes of low industrial land prices

In China, there is often a lack of capital for local government to promote economic growth (e.g., to develop industrial parks) (Xu et al., 2009). If a low industrial land price policy is conducive to attracting investment, then the government's behavior and policy is clearly rational. As is well known, urban development (and the development of industrial parks in particular) can produce beneficial effects on the accumulation of production factors to realize the economies of scale.

In the short term, the development of industrial land meets both government GDP targets and the employment needs of the population; while in the long-term, industrial development can provide a guarantee for future local fiscal revenue. Lishui City, as one of the relatively backward areas in Zhejiang Province, has been seeking the synchronization of modernization with the overall development of the province since entering the new millennium. Jinyun's strategy of *Using industry to make county powerful* echoes the spirit of regional planning in Lishui City.

表2
工业用地和住宅用地特性和价格基准关系的比较。

土地类型	行政办公和生活设施用地面积占总用地面积的比例 (RALO)		工业用地转换率 (CRIR)		
	用途和特点	住宅用地比例	转移年限	按照目前的利率 (5.94%)，它相当于价格的无限期百分比	工业用地与住宅用地的比例为
住宅用地	可以按计划进行住宅用地	1	70	98.3%	1
工业用地	7%的土地可以用作行政办公和生活设施可作为工人的住宅，因此涉及的土地面积相当于住宅用地	0.070	50	94.6%	0.9620

表3
工业用地和住宅用地转让价格的比较。

项目	住宅用地出让价格 (元/米 ²)	工业用地		CBPR/住宅用地转让价格 (%)
		土地出让价格 (元/米 ²)	CBPR (元/米 ²)	
2000–2010	3816	123	1826	48
2007–2010	4865	177	2629	54

2000年至2010年，工业用地和仓储用地在缙云新建成的864公顷土地中所占比例显著提高。新的城市建设用地可分为四类，包括公共行政和基础设施服务用地、工业和仓储用地、住宅用地和商业用地。根据2000年至2010年的统计数据，这四种类型的新增城市用地分别为257.38公顷、480.81公顷、112.65公顷和13.07公顷，其中工业用地和仓储用地占总用地的55.65% (图5)。

与缙云市2001–2020年城市总体规划相对应，工业和仓储用地49.9公顷，占城市总用地面积的13.1%。根据原《缙云市城市总体规划》，新建工业园区

仓储用地面积计划为93.0公顷，占城市总用地面积142.9公顷的16.9%。但实际上，新的工业和仓储用地面积增加到480.81公顷，占新的建设用地总量的55.65%。显然，原有的城市总体规划没有得到很好的实施，导致工业用地面积比例过大，从而阻碍了土地利用由粗放型向集约型的转变。

如上图所示，工业用地和仓储用地的比例过高，这是由相对较低的工业价格造成的 (图5)。因此，不断增长的工业用地已成为中国城市快速增长的关键驱动力。这一现象与本研究中的假设 (1) 相呼应。由于低工业地价政策，城市地区工业用地占绝大多数，这使得工业用地开发成为中国城市增长的主要动力。

蜈蚣博弈模型：工业用地价格低的原因

在中国，地方政府通常缺乏促进经济增长的资金 (例如，开发工业园区) (Xu等人，2009年)。如果低工业用地价格政策有利于吸引投资，那么政府的行为和政策显然是合理的。众所周知，城市发展 (尤其是工业园区的发展) 可以对生产要素的积累产生有利影响，从而实现规模经济。

在短期内，工业用地的开发既满足政府的GDP目标，又满足人口的就业需求；而从长远来看，工业发展可以为未来地方财政收入提供保障。丽水市作为浙江省相对落后的地区之一，自进入新千年以来，一直在寻求现代化与浙江省整体发展的同步。缙云以工业强县的战略与丽水市的区域规划精神相呼应。

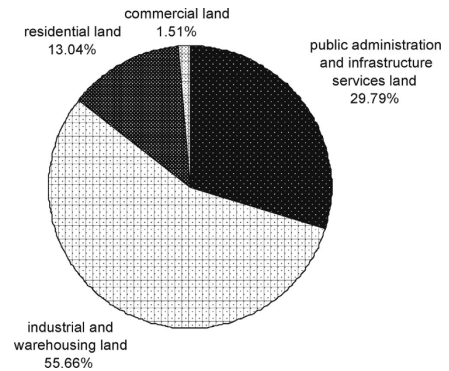


图5. 2000、2010. 缙云市新增建设用地比例。

Table 4

Game theory of land premium policy between regions L and J.

Policy of region L	Policy of region J J ₁ (normal land premium policy)	J ₂ (low land premium policy)
L ₁ (normal land premium policy)	Intensive land use Investment attraction is not affected	Region L ₂ : intensive land use; investment attraction is affected Region J ₂ : extensive land use; more investment attraction
L ₂ (low land premium policy)	Region L ₂ : extensive land use; more investment attraction Region J ₂ : intensive land use; investment attraction is affected	Extensive land use; investment attraction remains unaffected

Although the low industrial land premium policy is aimed at attracting investment in China, it actually results in a policy game played between regions. The results from the game theory analysis between regions not only affect the land use mode (whether it is intensive or extensive) but their attraction of foreign investment (see Table 4). When the total investment is fixed and other factors affecting investment remain the same, the land premium often becomes the determining factor in attracting investment. Suppose we need to decide whether to invest in regions L or J when they choose to adopt the normal land premium policy (J₁ and L₁ in Table 4), not only is land use intensified but the investment attractions from both sides remain unaffected. With a fixed total investment, investment attraction becomes a zero-sum game. Therefore, if region L adopts a low-premium policy, it will attract more investment with region J attracting less investment. If, to correct the situation, region J also adopts a low-premium policy, both the investment attractions are affected with extensive land use mode (see Table 4).

The GDP per capita in Jinyun has risen from \$700 in 2001 to \$3500 in 2010. In correspondence with the Hollis Chenery's patterns of development approach (Chenery, 1968), urban development at the expense of rural development can lead to a substantial loss of equality between internal regions of a country. Similar to experiences in North European Countries, Jinyun is currently undergoing a transition period from early to midterm industrialization, which makes it consistent in terms of overall growth in industrial land and economic development. The situation in Jinyun is also closely related to China's participation in the international division of labor since it entered the WTO in 2000. The significant influence of *Made in China* in the global context has also spawned a large number of industrial land areas. Similarly, a large-scale increase in industrial land is quite common in developed coastal areas and other parts of China. For example, land expropriation in the Heilongjiang Province in 2010 resulted in 48% of land earmarked for use in future industrial development.

There is a precedent for low industrial land prices in the initial stages of industrial development. For example, industrial park development policies were implemented in Hong Kong in 1977. Land prices in the 1980s within the industrial park were lowered to HK \$1000 m⁻² while the land price in the open public market at the same period was around HK \$4000–8000 m⁻² (Lao and Cai, 1992). This low industrial land price policy encouraged many manufacturers that were originally located in urban industrial buildings to relocate to more rural areas, thereby reducing the industries' negative impact on the urban environment. In this way, some well-known high-tech manufacturers were also attracted to Hong Kong. In contrast, although most of the regions in mainland China implemented a low industrial land price policy with the intention of attracting investment, it did not yield good results. The reasons for this have not been established although dynamic game theory offers some apparent insights.

One approach is to invoke *Centipede Game Theory*. This exists in many different versions (Aumann, 1998; Sperry-Taylor, 2011).

The earliest, put forward by Rosenthal (1981), was tailored for chain store pricing decisions under complete information. This is an extensive game form in which two players take turns choosing to take either a slightly larger share of a slowly increasing pot, or to pass the pot to the other player. This was later represented by a "Centipede Model" by Binmore (1987) involving two relevant parties in which players demonstrate a dynamic chess game.

In terms of the industrial land price issue, we assume that, if the loss incurred in reducing industrial land prices by local government is less than the investment income obtained, a price-cutting spiral occurs between regions. Now, assume the two regions each obtain '100' original revenue from land sales and the revenue generated after the attracting investment is also '100' each. Suppose the total amount of investment remains unchanged while the amount of attracted investment can be divided into several parts. For example, if there is 1% reduction in land price in the 'L' region, there might be a concomitant 2% increase in the normal premium returning to the revenues of the 'J' region. This process is demonstrated and depicted in Fig. 6.

This depicts the decision making process between the two sides (the L side is above the centerline, while the J side is below the centerline) and can be explained in term of a series of steps:

Step 1: Say the decision of 'L' is intended to be a "no trick" strategy. This means the two parties both take normal industrial land prices and are awarded with their individual revenues of attracted investment. The total amount of revenue is therefore 200 (100 land revenue and 100 investment revenue).

Step 2: When the J side is informed of the decision made by the L side, the J side proceeds to Step 2. In this case, the land price falls by 1%, resulting in an 2% increase in investment earnings so that the land price becomes 99, investment revenue 102, and total revenue 201 (which is better than the 200 in Step 1). Following the assumption made earlier, the total amount of investment remains unchanged. The increased foreign investment revenues are from the 'L' side, which results in lower total income of 198 on the 'L' side.

Step 3: The 'L' side is also individually rational, so it decides to reduce its land prices by 2%, 1% more than the 'J' side, to 98. The investment earnings from 'L' then become '102' and the total income '200' (which is better than L's total income of 198 in Step 2). At the same time, the total income of the 'J' side reduces to '197'. Step 4: In response, the 'J' side changes its strategy again by making a 3% reduction in land prices, which is 1% greater than the 'L' side. Investment earnings from 'J' are now '102' and the total income is '199' (which is better than J's total income of 197 in Step 3). At the same time, the total income of the 'L' side becomes '196'.

..... Step 101: By this time, the 'L' side lowers its land price to '0', which is 1% more than the 'J' side. The investment earnings from 'L' now become '102' with total income '102' (which is better than L's total income of 101 in Step 100). At the same time, the investment earnings and total income of 'J' are '98' and '99' respectively.

表4
土地溢价政策的博弈论。

L区政策	J区的政策 J ₁ (正常土地溢价政策)	J ₂ (低价政策)
L ₁ (正常土地溢价政策)	土地集约利用不影响招商引资	区域L ₂ : 土地集约利用; 投资吸引力受区域影响 J ₂ : 广泛的土地利用; 吸引更多投资
L ₂ (低价政策)	区域L ₂ : 广泛的土地利用; 吸引更多投资 J ₂ : 土地集约利用; 投资吸引力受到影响	土地利用粗放; 投资吸引力仍然不受影响

虽然低工业用地地价政策旨在吸引中国的投资, 但它实际上导致了地区之间的政策博弈。区域间博弈分析的结果不仅影响土地利用模式 (无论是集约型还是粗放型), 还影响其吸引外资的能力 (见表4)。当总投资固定且其他影响投资的因素不变时, 当地地价往往成为吸引投资的决定因素。假设我们需要决定, 当地区L或J选择采用正常的土地溢价政策 (表4中的J₁和L₁) 时, 是否投资于该地区, 不仅土地使用加剧, 而且双方的投资吸引力都不会受到影响。在总投资固定的情况下, 吸引投资变成了一个零和博弈。因此, 如果L区采取低价政策, 将吸引更多的投资, 而J区吸引的投资较少。如果为了纠正这种情况, J区也采取了低价政策, 那么这两个投资景点都会受到广泛土地使用模式的影响 (见表4)。

缙云的人均GDP从2001. 的700. 元上升到2010. 的3500. 元。与霍利斯·切纳里 (Hollis Chenery, 1968. 的发展模式相一致, 以牺牲农村发展为代价的城市发展可能导致一个国家内部地区之间的平等性大幅丧失。与北欧国家的经验类似, 缙云目前正在经历从早期工业化到中期工业化的过渡期, 这使其在工业用地和经济发展的总体增长方面保持一致。缙云的情况也与中国自2000. 加入世贸组织以来参与国际分工密切相关。中国制造在全球范围内的重大影响也催生了大量工业用地。同样, 在中国沿海发达地区和其他地区, 大规模增加工业用地也很常见。例如, 2010. 黑龙江省的土地征用导致48. 的土地被指定用于未来的工业发展。

在工业发展的初始阶段, 低工业用地价格是有先例的。例如, 工业园区发展政策于1977. 香港实施。20. 纪80. 代, 城市工业园区内的制造商迁往更多农村地区, 从而减少工业对城市环境的负面影响。这样, 一些知名高科技厂商也被吸引到了香港。相比之下, 尽管中国大陆大部分地区为了吸引投资而实施了低工业地价政策, 但并没有产生好的效果。虽然动态博弈论提供了一些明显的见解, 但其原因尚未确定。

一种方法是引用蜈蚣博弈论。这存在于许多不同的版本中 (Aumann, 1998; Sperry Taylor, 2011)。

罗森塔尔 (Rosenthal, 1981) 提出的最早的定价策略是为连锁店在完全信息下的定价决策量身定制的。这是一种广泛的游戏形式, 两名玩家轮流选择在缓慢增加的壶中占有稍大的份额, 或将壶传递给另一名玩家。后来, 宾莫尔 (Binmore, 1987) 提出了一个“蜈蚣模型”, 涉及两个相关方, 参与者在其中演示一个动态的国际象棋游戏。

关于工业用地价格问题, 我们假设, 如果地方政府因降低工业用地价格而产生的损失小于获得的投资收益, 则区域之间会出现降价螺旋。现在, 假设这两个地区各自从土地销售中获得“100”的原始收入, 并且吸引投资后产生的收入也各为“100”。假设总投资额保持不变, 而吸引的投资额可分为几个部分。例如, 如果“L”地区的地价下降1%, 那么“J”地区的正常地价可能会相应增加2%。图6展示并描绘了该过程。

这描述了双方之间的决策过程 (L侧位于中心线上方, 而J侧位于中心线下方), 可以通过一系列步骤进行解释:

第一步: 假设“L”的决定是一种“不要花招”的策略。这意味着双方均以正常的工业用地价格, 并获得各自吸引投资收入。因此, 总收入为200 (100土地收入和100投资收入)。步骤2. 当J侧被告知L侧做出的决定时, J侧进入步骤2. 在这种情况下, 土地价格下降1. 导致投资收益增加2. 从而土地价格变为99. 投资收入变为102. 总收入变为201. 这比步骤1. 的200.)。按照之前的假设, 投资总额保持不变。增加的外国投资收入来自“L”端, 这导致“L”端的总收入减少198.

第三步: “L”方也是个人理性的, 因此它决定将其土地价格降低2. 比“J”方多1. 降至98. 然后, “L”的投资收益变成“102. 总收入变成“200. (这比第2. 中L的总收入198. 好)。同时, “J”方的总收入降至“197. 第四步: 作为回应, “J”方再次改变策略, 将土地价格降低3. 比“L”方高出1. “J”的投资收益现在是“102. 总收入是“199. (这比第3. 中J的197. 收入要好)。同时, “L”方的总收入变为“196. 。

..... 第101步: 此时, “L”方将其地价降至“0”, 比“J”方高出1%。“L”的投资收益现在变成了“102”, 总收入为“102” (这比第100步中L的总收入为101要好)。同时, “J”的投资收益和总收入分别为“98”和“99”。

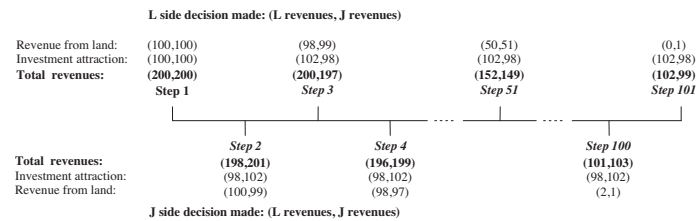


Fig. 6. The "Centipede Game Model": inter-regional dynamic industrial land prices.

Obviously, if there is no minimum limit to industrial land prices, the game eventually stays at Step 101 since this is the point of the zero limit of the land price. With minimum price policy restrictions, for example, a minimum transfer land price of 50% of the market price, the dynamic game theory process will stay at Step 51. In fact, as Fig. 6 implies, there are no fundamental changes in investment attractions in the regions 'J' and 'L'. In this way, therefore, a loss of land prices in both of the regions has occurred.

From a practical point of view, it should be noted that the Chinese government has identified the harm done by low industrial land prices, and the State Council issued an industrial land market-oriented policy in 2006 mandating the land bidding/auctions mode. However, the policy has not fundamentally solved the low industrial land price problem to date. The industrial land prices from 2000 to 2010 in Jinyun have not reflected market competition (Fig. 7) as they continued to be 100–150 yuan/m² from 2000 to 2007. Since 2007, land prices have actually accelerated as a result of the minimum industrial land price policy change.

The industrial land prices during the 2007–2010 period further suggest that the influence of market competition has dropped despite the increase in the minimum land price, with land prices generally ranging between 160–180 yuan/m² (Fig. 8). In addition, it has been demonstrated both theoretically and empirically that share price changes driven by market factors tend to follow a normal probability distribution (Praetz, 1972). However, as Fig. 8 shows, the distributional shape of Jinyun's industrial land price changes is far from that of a normal probability distribution, suggesting that changes in industrial land transfer are not driven by free market factors but by local government actions in endeavoring to attract investment.

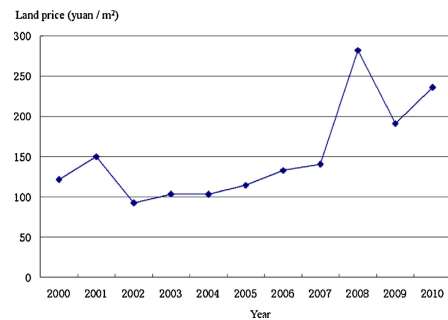


Fig. 7. Industrial land prices in Jinyun from 2000 to 2010.

Theoretically speaking, the price of land-use depends on land-use type, location, land-use density, and neighborhood externalities (Ding, 2003). Location plays a key role in determining the land price providing the land use types are same (e.g., all are industrial land). However, the above-mentioned phenomenon is not reflected in Fig. 8, where industrial land prices appear to be mostly similar irrespective of their location. Instead, the slope of the industrial land bidding curve in Fig. 1b other than Fig. 1a, indicates that the urban boundary is determined by the expansion of industrial land. The *Land bidding/auctions mode* of industrial land transfer does not promote the formation of a land market and no fundamental approach seems to be available to solve the problems of low industrial land prices. The industrial land prices appear to be concentrated within the range of 160–180 yuan/m², which reflects the phenomenon of the low industrial land price policy mandated by local government (Fig. 8). As Wu (2007) suggests, this may be due to the intensity of inter-regional competition in attempting to attract foreign investment.

The direct competitor of Jinyun is the Liandou district – the only political city center nearby – with Jinyun County and Liandou both being on the railway and highway to Shanghai and Hangzhou. After the tax system reforms in 1994, the central government's fiscal revenue has kept increasing year by year, although the local government's fiscal revenue has reduced in recent years (Jia and Yan, 2005). In order to resolve the shortage of funds resulting from the process of industrialization, the Liandou government has adopted a strategy of attracting foreign investment through low industrial land prices and hence helping to maintain similarly low prices of its regional neighbors.

The mean of industrial land price in Lishui is 159 yuan/m², while that of Jinyun County is 177 yuan/m², which is similar to the

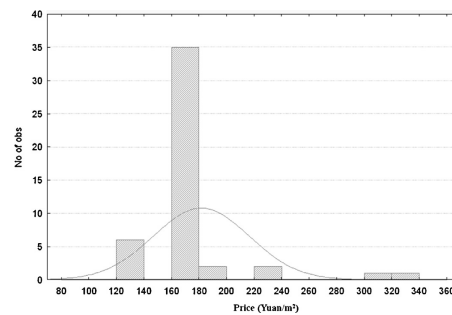


Fig. 8. Industrial land prices in Jinyun from 2007 to 2010.

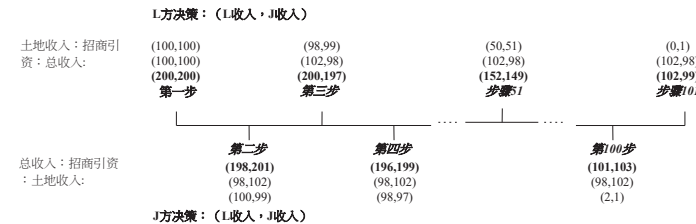


图6. “蜈蚣博弈模型”: 区域间动态工业用地价格。

显然, 如果工业用地价格没有最低限制, 游戏最终会停留在步骤 101. 因为这是地价的零限制点。例如, 在最低价格政策限制下, 最低转让地价为市场价格的 50%, 动态博弈论过程将停留在步骤 51. 事实上, 如图 6 所示, “J”和“L”区域的投资吸引力没有根本性变化。因此, 通过这种方式, 这两个地区的土地价格都出现了损失。

从实践的角度来看, 应该指出的是, 中国政府已经发现了低工业用地价格带来的危害, 国务院在 2006 年发布了一项以工业用地市场为导向的政策, 规定了土地招拍/拍卖模式。然而, 到目前为止, 该政策尚未从根本上解决工业用地价格低的问题。缙云市 2000 年至 2010 年的工业用地价格没有反映市场竞争 (图 7), 因为从 2000 年至 2007 年, 工业用地价格持续在 100–150 元/米² 之间。自 2007 年以来, 由于最低工业用地价格政策的变化, 土地价格实际上已经加快。

2007–2010 年期间的工业用地价格进一步表明, 尽管最低地价有所提高, 但市场竞争的影响有所下降, 地价一般在 160–180 元/米² 之间 (图 8)。此外, 理论和经验都证明, 由市场因素驱动的股份变化往往遵循正态概率分布 (Praetz, 1972)。然而, 如图 8 所示, 缙云市工业用地价格变化的分布形状远远不是正态概率分布, 这表明工业用地转让的变化不是由自由市场因素驱动的, 而是由地方政府努力吸引投资的行为驱动的。

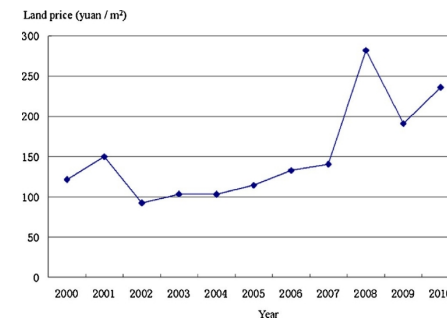


图7. 2000 年至 2010 年缙云工业用地价格。

从理论上讲, 土地使用价格取决于土地使用类型、位置、土地使用密度和社区外部性 (丁, 2003)。如果土地使用类型相同 (例如, 所有土地均为工业用地), 则位置在确定土地价格中起着关键作用。然而, 上述现象并未反映在图 8 中, 图 8 中的工业用地价格似乎基本相似, 无论其位置如何。相反, 图 1b (图 1a 除外) 中工业用地竞价曲线的斜率表明, 城市边界由工业用地的扩张决定。工业用地转让的土地招拍/拍卖模式并没有促进土地市场的形成, 似乎也没有根本的办法来解决工业用地价格低的问题。工业用地价格似乎集中在 160–180 元/米² 的范围内, 这反映了地方政府强制实施的低工业用地价格政策的现象 (图 8)。正如 Wu (2007) 所指出的, 这可能是由于试图吸引外国投资的区域间竞争的激烈。

缙云的直接竞争对手是连斗区 – 附近唯一的政治城市中心 – 缙云县和连斗都在通往上海和杭州的铁路和公路上。1994 年税制改革后, 中央政府的财政收入逐年增加, 但近年来地方政府的财政收入有所减少 (贾和闫, 2005)。为了解决工业化进程中的资金短缺问题, 连斗政府采取了通过低工业用地价格吸引外国投资的战略, 从而帮助保持该地区邻国同样的价格。

丽水市工业用地均价为 159 元/米², 缙云县工业用地均价为 177 元/米², 与之类似。

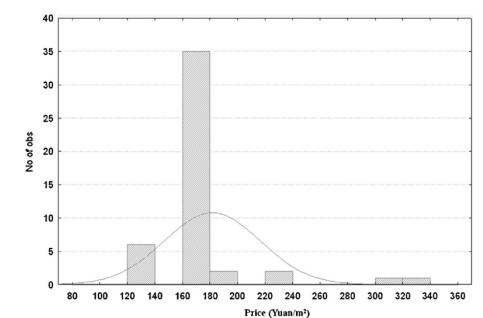


图8. 2007 年至 2010 年缙云市工业用地价格。

Liandou District, higher than other counties and lower than the Qingtian County (229 yuan/m²). This is caused largely by the behavior of the various parties involved and forces all to maintain low limit transfer land price levels. In fact, examining the relationships involved in industrial land transfers in game terms need be not only limited to the Lishui City in Zhejiang Province, but also competition in the Yangtze River Delta region, and even China and Southeast Asia as a whole.

Overall, it can be concluded from the Centipede Game Model as well as the evidence from Jinyun case that the causes of low industrial land price are the intensity of inter-regional competition to attract foreign investment. In this context, as shown in Fig. 1b, the slope of the industrial land rent-bidding curve will become flattened significantly, which leads to the urban sprawl phenomenon seen in many cities of China and the evidence from the Centipede Game Model is echoed with Hypothesis 2. In other words, the low land premium policy under the background of regional investment competition has interfered with the land leasing market, which influences the urban spatial structure, leading to the phenomenon of outside industrial land unfolding in the form of the expression “urban space structure expands like standing pancake”.

Discussion

The role that the industrial land premium has played in China's urban expansion is inseparable from China's position as the “World factory”. Though county-level government in China is politically centralized, inter-county competition is very intensive. For example, the construction of industrial parks is not only pegged to the county's financial system but also acts as a critical factor in the performance evaluation of local officials. Therefore, there should be reasonable inter-regional planning guidance to achieve inter-regional “win-win” development in the future.

• Local financial system

The strategy by local government to adopt a low industrial land transfer price is determined to some extent by local financial considerations. A significant local government source of income is through Value-added Tax (VAT), accounting for approximately 60% of overall tax revenue (Bai, 2010). Therefore, it is in the local government's fund-raising interest to attract as much foreign investment as possible for building factories in order to secure the associated VAT returns. This has in fact become the root cause of the current so-called low-level redundant construction throughout China (Wang, 2004). In contrast, the main sources of government revenue in many developed countries are property taxes. For example, local government property taxes in the USA in 1975 accounted for 51.2% of total tax revenue (Barlowe, 1978). This is due to property tax being transparent and stable – providing a steady stream of revenue for local governments (Youngman and Malmé, 2004).

Since the beginning of 2011, China has been trialing property taxes in Shanghai, the largest city by population in the People's Republic of China (Shanghai Municipal Government, 2011). To date, however, the property tax is being used mainly to curb the rapid increase of housing prices in these locations (Han et al., 2011). In view of what has been written above, it would seem that China would benefit more in future from a property tax levy to provide a stable source of finance for local governments. In addition, such a move could also provide some social equity concerning resource consumption and enable the city to provide infrastructure and production space as well as living space, obviating the current overreliance on foreign investment in industrial park building.

• Local government performance evaluation

Since Deng Xiaoping's *Development is the absolute principle* theme, a number of local governments now pay most of their attention to revenue generation at the expense of the local ecological environment (Managia and Kanekob, 2009). In particular, the accelerated development of industrial parks has resulted in a weakening of pollution control in these areas, leading to serious environmental degradation. For example, Qiantang River, the largest in Zhejiang Province, plays a critical role in water supply, electricity generation, irrigation, tourism, fishery and shipping in the Qiantang River basin. As is acknowledged by Su et al. (2011), the Qiantang River basin is one of the most rapidly advanced economic regions in China, and is now known as ‘the world's workshop’. However, it is widely acknowledged that the water quality of the Qiantang River continues to deteriorate, mainly due to industrial wastewater pollution (Huang et al., 2010). Compared with the previous year, the changes Zhejiang province's industrial wastewater yearly discharge rates in the period of 2006–2010 are “+3.74%”, “+0.50%”, “–7.58%”, “+1.45%”, and “+6.88%” respectively (Zhejiang Environmental Protection Office, 2011). Therefore, it is obvious that, with the exception of the decreased rate of “7.58%” in 2008 due to the Global Financial Crisis (GFC) affecting industrial production and causing a fall in the production of industrial wastewater emissions, the rate of industrial wastewater discharge is generally increasing. In addition to water pollution, air quality and heavy metal soil pollution are also very serious issues, creating a potential health hazard for many local residents (Chan and Yao, 2008; Li et al., 2009). A change is therefore needed from the current GDP based revenue focus of local government to one that places greater emphasis on people's livelihood and environmental protection.

• Regional planning

By using the “centipede game model” in Jinyun County, the economic theory of “fallacy of composition” was illustrated. That is, although the individual (non-cooperative) strategy of each local government is locally rational, the intensity of competition is such that the combined effect of all the local governments involved is non-rational. One approach to overcoming this is to establish cooperative relationships between the regions to reduce the intensity of the competition. In an attempt to do this, the State Council have adopted a Development Priority Zoning (DPZ) strategy and which, bearing in mind the importance of the region, may have a significant impact on the regional land use in China (Wu et al., 2011).

The overall industry production in China is characterized by the “excess production capacity” of very similar types of industries. Possibilities for diversification exist, however, that may offer increased benefits in addition to relieving some of the current intense competition. For example, by matching industry development plans more to the economic conditions of the Counties. Taking Lishui city as an example, the Liandou district, Jinyun County and Qingtian County, being more economically developed, make it more rational to develop an ecological industry (such as tourism) in other mountainous counties in line with the DPZ strategy. In short, it may be better for local government to transfer land development rights from those mountainous counties to other counties with better locations. In this way, a transfer payment system among regions could be established to avoid overly intense competition, improve industrial land transfer prices and hence correcting the current land use imbalance hindering agricultural facilities and production.

China's commitment to a market economy could hardly allow such an arrangement to continue. What is needed in the longer term, is a comprehensive reform of the local financial system, government performance evaluation, and regional planning.

连斗区，高于其他县，低于青田县（229元/米²）。这在很大程度上是由相关各方的行为造成的，并迫使所有各方保持最低的转让地价水平。事实上，从博弈的角度审视工业用地转让所涉及的关系，不仅需要局限于浙江省丽水市，还需要包括长江三角洲地区乃至中国和整个东南亚的竞争。

总体而言，从蜈蚣博弈模型以及缙云案例的证据可以得出结论，工业用地价格低的原因是区域间吸引外资竞争的激烈程度。在这种情况下，如图1所示，工业用地租金-投标曲线的斜率将显著变平，这将导致中国许多城市出现城市蔓延现象，蜈蚣博弈模型的证据与假设2呼应。换句话说，区域投资竞争背景下的低价政策干扰了土地租赁市场，影响了城市空间结构，导致外部工业用地以“城市空间结构像煎饼一样膨胀”的形式展开。

讨论

工业用地溢价在中国城市扩张中所起的作用与中国作为“世界工厂”的地位密不可分。虽然中国的县级政府在政治上是中央集权的，但县际竞争非常激烈。例如，工业园区的建设不仅与该县的金融体系挂钩，而且也是地方官员绩效评估的关键因素。因此，未来要实现区域间的“双赢”发展，就必须有合理的区域间规划指导。

• 地方金融体系

地方政府采取低工业用地出让价格的策略在一定程度上取决于地方财政考虑。地方政府的一个重要收入来源是增值税（VAT），约占总税收的60%（Bai，2010）。因此，吸引尽可能多的外国投资建厂，以确保相关增值收益，符合地方政府的筹资利益。事实上，这已成为当前中国各地所谓的低水平重复建设的根本原因（王，2004）。相比之下，许多发达国家政府收入的主要来源是财产税。例如，1975年美国地方政府财产税占总税收的51.2%（Barlowe，1978）。这是因为房产税透明且稳定，为地方政府提供了稳定的收入来源（Youngman and Malmé，2004）。

自2011年初以来，中国一直在中国人口最多的城市上海试行房产税（上海市政府，2011年）。然而，到目前为止，房产税主要用于遏制这些地区房价的快速上涨（Han等人，2011年）。鉴于以上所述，中国未来似乎将从征收房产税中获得更多好处，从而为地方政府提供稳定的资金来源。此外，这一举措还可以在资源消耗方面提供一定的社会公平，使该市能够提供基础设施、生产空间和生活空间，避免目前工业园区建设过度依赖外国投资。

• 地方政府绩效评估

由于邓小平的发展是一个绝对的主题，许多地方政府现在大多关注创收，而牺牲了当地的生态环境（Managia和Kanekob，2009）。特别是，工业园区的加速发展导致这些地区的污染控制减弱，导致环境严重退化。例如，钱塘江是浙江省最大的河流，在钱塘江流域的供水、发电、灌溉、旅游、渔业和航运方面发挥着关键作用。正如Su等人（2011）所承认的，钱塘江流域是中国经济发展最快的地区之一，现在被称为“世界工厂”。然而，人们普遍认为钱塘江的水质继续恶化，主要是由于工业废水污染（Huang等人，2010）。与上年相比，2006–2010年浙江省工业废水年排放率的变化分别为“+3.74%”、“+0.50%”、“+7.58%”、“+1.45%”和“+6.88%”

（浙江省环境保护厅，2011年）。因此，很明显，除了2008年由于全球金融危机（GFC）影响工业生产并导致工业废水排放量下降导致的“7.58%”的下降率外，工业废水排放率普遍在上升。除了水污染，空气质量和重金属土壤污染也是非常严重的问题，对许多当地居民造成了潜在的健康危害（Chan和Yao，2008；Li等人，2009）。因此，需要改变地方政府目前以GDP为基础的收入重点，转而更加重视民生和环境保护。

• 区域规划

利用缙云县的“蜈蚣博弈模型”，阐述了“成分谬误”的经济学理论。也就是说，尽管每个地方政府的个别（非合作）战略在当地是理性的，但竞争的强度使得所有参与的地方政府的综合效应是非理性的。克服这一问题的一种方法是在各地区之间建立合作关系，以降低竞争的强度。为了实现这一目标，国务院采取了发展优先区划（DPZ）战略，考虑到该地区的重要性，该战略可能会对中国的区域土地利用产生重大影响（Wu等人，2011年）。

中国整个工业生产的特点是非常相似类型的工业“产能过剩”。然而，多样化的可能性是存在的，除了缓解当前激烈的竞争之外，它还可能带来更多的益处。例如，通过使产业发展计划更符合县的经济条件。以丽水市为例，经济较为发达的连斗区、缙云县和青田县，使其其他山区县按照DPZ战略发展生态产业（如旅游业）更加合理。简言之，地方政府最好将这些山区县的土地开发权转让给其他位置更好的县。通过这种方式，可以建立区域间的转移支付制度，以避免过度激烈的竞争，提高工业用地转让价格，从而纠正目前阻碍农业设施和生产的土地利用不平衡。

中国对市场经济的承诺很难让这种安排继续下去。从长远来看，需要对地方金融体系、政府绩效评估和区域规划进行全面改革。

Conclusions

China is now experiencing a rapidly advancing industrialization stage, with its own rationale toward industrial land development based on changing from an extensive to intensive form of urban land use. However, attempting to attract foreign investment by a low industrial land price strategy at the County level has resulted in a disproportionately large amount of industrial land within the total urban land use structure at the expense of land needed for agriculture. The main cause of this situation appears to be the intense competition from other counties because of their adoption of the same strategy, a phenomenon reproduced by the "centipede game model" presented in this paper. As Wu (2007) points out, the vicious competition is likely to bring about chaos to China's industrial layout, reducing the core competitiveness of China's industrial products in the international market in the long run.

One possible approach to redressing this situation would be to establish inter-regional cooperative partnerships aimed at avoiding future cutthroat competition and price wars. Also, a multi-pronged approach from financial institutions and regional planners as well as local government performance evaluation measures may ultimately achieve the change from extensive to intensive urban land use needed. From a practical industrial land management perspective, the former would be a short-term strategy to ensure a reasonable minimum level of industrial land transfer prices and therefore indirectly regulate the amount of industrial land available. This should have the effect of raising and stabilizing the price of industrial land generally in China in future. Meanwhile, however, it is crucial to monitor the industrial land premium rationally to control the regional competition between regions, which can further achieve the shift needed from the extensive to intensive land use mode in order to obtain sustainable economic growth in China in the long run.

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结论

中国正在经历一个快速推进的工业化阶段，其工业用地开发的理论基础是城市土地利用从粗放型向集约型转变。然而，试图通过县一级的低工业用地价格战略吸引外国投资，导致城市土地利用总体结构中的工业用地数量过多，而农业所需的土地却受到了损害。这种情况的主要原因似乎是其其他国家由于采用相同的战略而产生的激烈竞争，这一现象在本文提出的“蜈蚣博弈模型”中重现。正如吴（2007）所指出的，恶性竞争可能会给中国的产业布局带来混乱，从长远来看，会降低中国工业产品在国际市场上的核心竞争力。

纠正这种情况的一种可能方法是建立跨区域合作伙伴关系，避免未来的残酷竞争和价格战。此外，金融机构和区域规划师以及地方政府绩效评估措施的多管齐下可能最终实现从粗放型城市土地利用向集约型城市土地利用的转变。从实际的工业用地管理角度来看，前者将是一种短期战略，以确保工业用地转让价格达到合理的最低水平，从而间接调节可用工业用地的数量。这将对未来中国工业用地价格的普遍上涨和稳定产生影响。但同时，合理监控工业用地地价对于控制区域间的区域竞争至关重要，从而实现从粗放型土地利用模式向集约型土地利用模式的转变，从而实现中国经济的长期可持续发展。

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