Land Use Changes and Economic Growth in China

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The conversion of land from agricultural production to urban and industrial development is one of the critical processes of change in developing economies undergoing industrialization, urbanization, and globalization. Urban land use changes taking place in China have attracted much scholarly attention, especially in light of the extensive economic reforms, remarkable economic growth, and profound structural changes over the last three decades. The transition from a planned to a market economy and from authoritarian to more decentralized provincial and local government has generated a new institutional setting for changes in land use (Lin and Ho 2005).

The prevailing view is to characterize land use change as the outcome of economic growth and structural change. This argument aligns itself with the neoclassical growth model in which land plays a decreasing role in economic growth. However, these changes in land use can be both the consequence of economic growth and the drivers of such growth (Bai, Chen, and Shi 2011; Ding and Lichtenberg 2011).

The reality is much more complicated. Instead of being driven by growing population, urban land expansion in China is motivated by land finance, whereby local governments raise revenue and attract investment by leasing and developing land. As a result, land-centered urban policy has been identified as one of the most important driving forces operating behind the spectacular expansion of cities since the mid-1990s (Lin 2007). Supplying agricultural land for nonagricultural purposes effectively allows the local government to "kill many birds with one stone" (Ping 2011). As a result, land development fuels economic growth, especially in urbanized areas.

Land use changes in China are also affected in significant ways by land supply policies, which have been adjusted regularly to meet the demands of economic development. Illegal land supply is a leading cause of excessive and uncontrolled investment, which occurs when local governments do not supply land to land users according to current land use plans or following the final permission of the central government. As a result, the central government started to use land policy as a major aspect of national macro-economic control in late 2003.

Among other measures, land transfers have been conducted through auction or tender since 2004, and land supply policy has shifted from quantity control to structural control since 2006. Land use indexes distributed by the central government to the local governments emphasized only the quantity of land before 2006, but currently the distribution of land uses among categories is set by the central government and even the intensity of land use is defined.

This legacy can be seen in the State Council's establishment of the highly centralized State Land Supervision (SLS) system in 2006. Nine new regional offices were charged with investigating illegal land supply across the country (Tao et al. 2010). The new land policy has played an active role in improving land use by forbidding land to be leased to projects inconsistent with national industrial policy, development plans, and entry standards. Following the introduction of these reforms, the amount of land supplied illegally has decreased greatly due to stringent control, while

TABLE 1
Land Use Changes in China, 2004–2008

Major Land Use Categories	Land Use Composition (%)		Land Use Change (2004–2008)	
	2004	2008	Rate of Change (%)	Change of Area (million mu)
Agricultural Land	69.11	69.10	– 0.01	– 0.72
Cultivated Land	12.88	12.80	– 0.61	– 11.27
Orchards	1.19	1.24	4.72	7.99
Forestland	24.72	24.84	0.45	15.87
Pasture	27.63	27.54	– 0.32	– 12.69
Other Agricultural Land	2.69	2.68	– 0.16	– 0.63
Construction Land	3.32	3.45	3.98	18.83
Settlements and Industrial/Mining Sites	2.71	2.81	3.87	14.92
Cities	0.18	0.22	19.61	5.12
Designated Towns	0.17	0.20	13.33	3.32
Rural Settlements	1.74	1.74	– 0.09	– 0.22
Stand-alone Industrial/Mining Sites	0.38	0.43	12.42	6.70
Transportation Land	0.23	0.26	9.89	3.31
Railways	0.04	0.04	7.01	0.39
Highways	0.19	0.21	10.35	2.79
Land for Water Conservancy Facilities	0.38	0.38	1.11	0.60
Unused Land	27.57	27.44	– 0.46	– 17.91
Unused Land (potentially developable)	24.47	24.35	– 0.48	– 16.70
Other Unusable Land	3.10	3.09	– 0.27	– 1.22

Note: 1 hectare (ha) = 15 mu; 1 million mu = 666.666 thousand hectares.
Source: Ministry of Land and Resources (2008).

GDP generated per unit of developable land has increased substantially (China Land and Mine Resources Law Center 2007). It is expected that this stringent land policy will have a significant impact on the spatial pattern of land use and may affect the association between land use changes and economic growth in China.

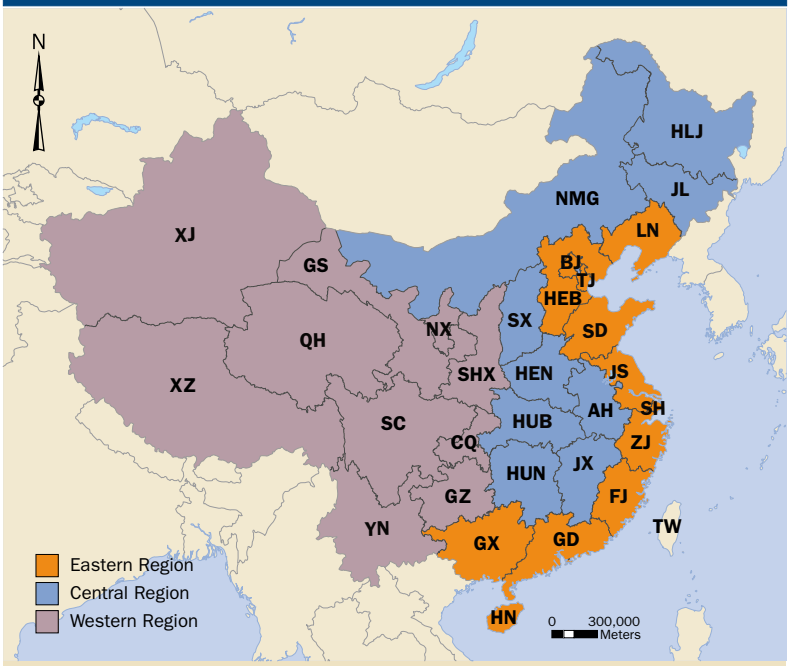
Changes in Land Use Patterns Across China

Land policy in China has changed dramatically since 2004, and one would also expect a different pattern of land use since then. Based on official county-level data from 2004 and 2008, we examine land use change at the provincial prefecture city level and explore the spatial relationship between land use change and economic growth. Official land use change data are divided into several land use categories at three levels every year. The first level includes agricultural land, construction land, and unused land; the second level contains ten categories of land uses; and the third level contains 52 subcategories.

Table 1 shows land use changes nationally from 2004 to 2008, during which time more land was converted into uses for construction while the amount of agricultural land and unused land declined. Among agricultural land categories, pasture land and cultivated land shrank by 12.69 million mu (0.85 million hectares) and 11.27 million mu (0.75 million hectares) respectively. Unused land fell by 17.91 million mu (1.19 million hectares).

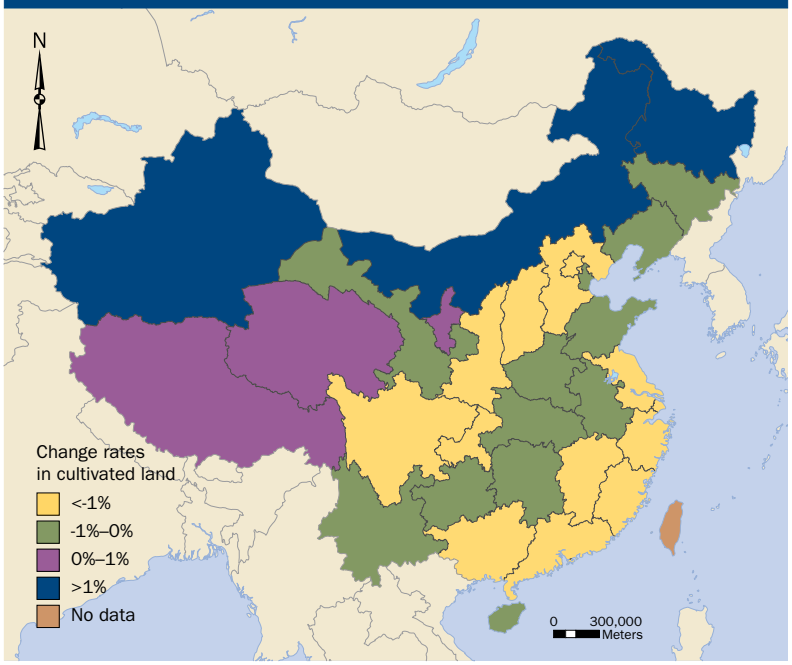
Given recent rapid industrialization and urbanization, it is not surprising that the fastest land conversions in China have been to construction uses, which added 18.83 million mu (1.26 million hectares).

FIGURE 1
Location of Chinese Provinces



AH: Anhui
BJ: Beijing
CQ: Chongqing
FJ: Fujian
GD: Guangdong
GS: Gansu
GX: Guangxi
GZ: Guizhou
HEB: Hebei
HEN: Henan
HLJ: Heilongjiang
HN: Hainan
HUB: Hubei
HUN: Hunan
JL: Jilin
JS: Jiangsu
JX: Jiangxi
LN: Liaoning
NMG: Inner Mongolia
NX: Ningxia
QH: Qinghai
SC: Sichuan
SD: Shandong
SH: Shanghai
SHX: Shaanxi
SX: Shanxi
TJ: Tianjin
TW: Taiwan
XJ: Xinjiang
XZ: Xizang (Tibet)
YN: Yunnan
ZJ: Zhejiang

FIGURE 2
Changes in Cultivated Land in Chinese Provinces, 2004–2008



Source: Ministry of Land and Resources (2008).

In the category of settlements and industrial/mining sites, cities, designated towns, and industrial/mining sites witnessed the fastest land expansion, with growth rates of 19.61, 13.33, and 12.42 percent respectively, while the land area of rural settlements decreased. Significant amounts of land were also converted for the use of transportation, particularly the construction of highways.

This national-level analysis hides many spatial variations in land use changes in particular provinces and regions (figure 1). Thus we explore land use changes at the provincial level, focusing on the changes to cultivated land, urban land (including cities and designated towns), stand-alone industrial/mining sites, rural settlements, and transportation land for highways.

Figure 2 shows that losses of cultivated land occurred mainly in eastern and central China. Economic growth, urbanization, and industrialization have accelerated in Hebei, Jiangsu, Zhejiang, Guangdong, and Guangxi provinces, where the most cultivated land was converted to urban, industrial, and transportation purposes. Shanxi, Shaanxi, Chongqing, and Sichuan provinces also saw rapid conversion of cultivated land to nonagricultural activities. Those provinces are located in China's transitional geographic belt, where cultivated land is the best choice for construction and development. In contrast, inland provinces including Tibet, Qinghai, Xinjiang, Inner Mongolia, and Heilongjiang saw some increases in cultivated land.

Land for rural settlements is influenced by both new countryside policies and rural income growth. Increases in income have influenced the conversion of land to rural settlements in the eastern provinces such as Guangdong, Fujian, Zhejiang, Guangxi, Hebei, and Tianjin, and in some inland provinces including Heilongjiang, Inner Mongolia, Xinjiang, Qinghai, Tibet, Yunnan, Guizhou, Hubei, and Shanxi. However, some provinces experienced significant decreases in land used for rural settlements, particularly in Jiangsu, Jiangxi, and Anhui. This decline may be associated with new countryside policies, which have actually forced farmers into towns.

Urbanization and industrialization are the major drivers of nonagricultural land expansion in China. The urbanization rate grew from 40.50 to 45.68 percent between 2004 and 2008, when all provinces experienced urban and industrial land

expansion (figure 3). However, most urban land expansion occurred south of the Yangtze River. In the north, only Shandong, Anhui, and Jiangsu experienced substantial urban and industrial land changes.

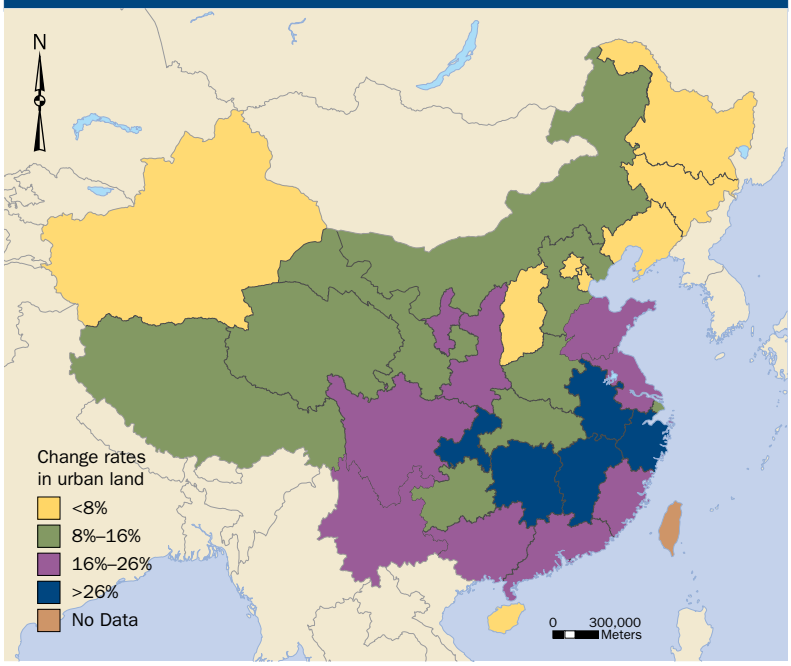
The rapid growth in the amount of land used for industrial/mining sites is seen largely in the eastern provinces, both in terms of absolute and relative changes, especially in Fujian, Jiangsu, Zhejiang, and Hebei (figure 4). With relatively smaller growth rates, Guangdong, Shandong, and Liaoning also saw a large amount of land converted to industrial/mining sites. The western provinces of Inner Mongolia, Qinghai, and Tibet witnessed rapid growth of land for industrial/mining sites but small absolute growth.

From 2004 to 2008, China launched a major drive to develop transportation networks by building more railways and highways to support economic growth. Nationally, land used for transportation grew at about 10 percent during this period. Many provinces witnessed faster growth in land used for transportation than the nation as a whole, including Inner Mongolia, Hebei, Qinghai, Jiangsu, Zhejiang, Fujian, Chongqing, Hubei, Anhui, Jiangxi, and Guangxi. Land requisition for highways was largely concentrated in the eastern provinces, with the largest absolute increases in Zhejiang, Jiangsu, and Hebei provinces.

Overall, China has witnessed remarkable land use changes, particularly in the eastern provinces and some central provinces. The spatial pattern of land use change is consistent with the spatial shift of economic growth, because eastern provinces enjoy institutional and locational advantages and agglomeration economies. They have attracted the majority of foreign investments, particularly those in capital- and technology-intensive industries, and are the dominant exporters of Chinese products.

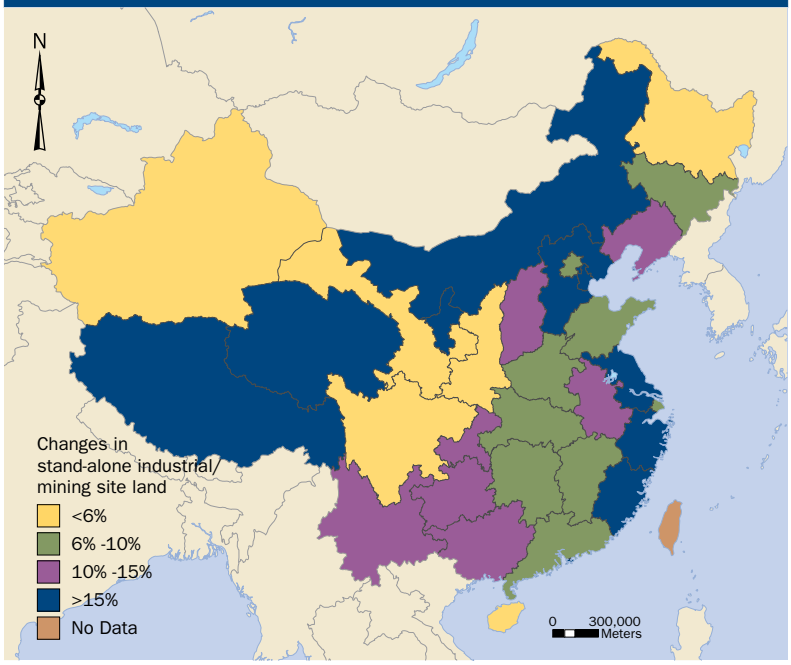
Acceptance into the World Trade Organization has further benefited industrial firms located in eastern China with greater access to international markets. On the other hand, as industries continue to agglomerate, the eastern region has experienced rising land, workforce, and environmental costs, forcing some traditional industries to move to the central provinces. Some of these areas have attracted more recent investment and experienced faster economic growth, thus raising their importance among China's regional economies.

FIGURE 3
Changes in Urban Land (Cities and Designated Towns) at the Provincial Level, 2004–2008



Source: Ministry of Land and Resources (2008).

FIGURE 4
Changes in Stand-Alone Industrial/Mining Sites at the Provincial Level, 2004–2008



Source: Ministry of Land and Resources (2008).

Correlations Between Land Use Change and Economic Growth

To investigate the relationship between land use changes and economic growth systematically across cities and provinces, we calculate the correlation coefficients between the GDP growth rate from 2005 to 2009 and the rate of change of different land categories. The extent of the correlation may depend on a variety of economic, locational, and institutional conditions. We examine the impact of city size, location, and industrial structure, the amount of foreign direct investment (FDI), and land supply constraints on the relationship between land use changes and economic growth. The correlation coefficients are further computed using city subsamples classified by those factors.

The unexpected results showed that only a few significant but small correlation coefficients exist between the rate of change in land use and the economic growth rate (He, Huang, and Wang 2012). The change in other transportation land (including airports, ports, and pipelines) holds a significant positive coefficient. Correlation coefficients for urban land, industrial/mining sites, railways, and highways are barely significant.

Some evidence shows that city size, geographical location, fiscal situation, land supply, and realized FDI may moderate the correlation between land use change and economic growth. For instance, urban land expansion is associated with economic growth positively in central China but negatively in eastern and western regions. Stand-alone industrial/mining sites increase significantly with economic growth in western China. But overall, the correlation between the rate of land use change and economic growth is rather weak.

Since land can be treated as an input in the production function, the quantity of land may contribute directly to GDP growth. We compute the correlation coefficients between absolute GDP growth from 2005 to 2009 and absolute land use change from 2004 to 2008 to explore this relationship and find they are strongly correlated. Nationally, more cultivated land converted to nonagricultural uses contributes significantly to absolute GDP growth, with a correlation coefficient of -0.26. More land for urban uses and industrial/mining uses, are significantly and positively associated with GDP increases.

Significant correlation coefficients between land use change and economic growth suggest that land has been a significant driver of economic growth, but this positive contribution is moderated by a variety of factors including a city's size, location, industrial structure, fiscal condition, and utilization of FDI. Conversion of cultivated land to nonagricultural uses is shown to contribute to economic growth, particularly in cities with more than 5 million people, realized FDI greater than US$200 million, strong agricultural land constraints, secondary industrial domiance, and location in central China.

Clearly, nonagricultural land is more productive than cultivated land in large and industrial cities. In recent years, as the implementation of central government policies targeted development in central China, the inland provinces have attracted more domestic and foreign investment and seen rapid economic growth as cultivated land has been converted to urban and industrial uses.

Comparatively, urban land expansion holds a stronger correlation with GDP growth in smaller cities and those located further inland. These types of cities are more likely to depend on land leasing to generate local revenues since they face more stringent fiscal constraints. In these areas, capital accumulation from land leasing is a typical local development strategy. In addition, urban land expansion plays a larger role in stimulating economic growth when fiscal limitations are steeper, land supply is strictly controlled, tertiary industries dominate, and more foreign investment is utilized. Industrial land expansion also contributes significantly to economic growth, especially in cities with stringent fiscal constraints and more industrial activities.

The recent transportation infrastructure development boom has contributed to economic growth as well. Land expansion for highways has stimulated economic growth with no constraints. Cities located in the western regions and those with poor fiscal revenues particularly benefit from new highways while expansion of railways is less associated with economic growth. The building of other transportation infrastructure (airports, ports, and pipelines) has played a critical role in facilitating economic growth in smaller and more eastern cities as well as in those whose economies are dominated by service industries.

The correlation analysis provides clear evidence to show that urban, industrial, and transportation land expansion is positively and significantly associated with economic growth. Converting cultivated land has contributed to economic expansion in

many regions of China, but the importance of nonagricultural land expansion in economic growth is moderated by social, economic, and geographical conditions.

Conclusion and Discussion

Since the implementation of its economic reform, China has pursued a resource-intensive growth model that has forced land to play a critical role in sustaining its rapid economic growth. This has resulted in a large supply of developable land and rapid conversion from agricultural to nonagricultural purposes. Land in China is not only the outcome of economic growth but is also its driver.

The conversion of cultivated land to nonagricultural uses has been concentrated in the eastern and central parts of the country. With the implementation of new countryside development strategies and the enforcement of stricter land supply constraints, China witnessed a reduction in rural settlements across most of the central and northeastern regions. Urban and industrial land expansion has dominated land use changes throughout the nation. Transportation development, including new highways, railways, airports, seaports, and pipelines, has also been a major cause of land consumption in recent years, particularly in the eastern and central regions.

The principle component analysis based on land use change data from prefecture level cities indicated substantial spatial variation in land use changes among Chinese cities and showed that they are auto-correlated spatially. Correlation analysis further showed a weak relationship between the growth rate of GDP and the rate of land use change. But absolute land use change and absolute GDP growth are strongly correlated, indicating that land quantity is a critical input in economic growth.

Land is usually regarded as playing a marginal role in economic growth in Western economic growth theories. Our exploratory analysis suggests the opposite in China. As China urbanizes, industrializes, and globalizes, it is experiencing substantial land use changes that are correlated with economic growth. This significant relationship is associated with China's particular state-owned land ownership and land use rights systems. As such, land can be used as a powerful macroeconomic intervention tool. The long-term lease of land use rights grants incentives for local governments to sell land to generate lump-sum revenues, which are then used to finance urban and industrial development and infrastructure provision.

Consequently, land has played a critical role in China's rapid economic growth. However, this form of land-centered urbanization and industrialization has already caused serious social tensions, environmental degradation, and economic fluctuation. The lump-sum revenues generated by land leases are not sustainable considering that, even as large as it is, China has a limited land supply. The role of land as a driver of economic growth can be expected to decline as China gradually undergoes industrial advancement.

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