JOURNAL OF REGIONAL SCIENCE

JOURNAL OF REGIONAL SCIENCE, VOL. 51, NO. 2, 2011, pp. 299–317

LAND AND URBAN ECONOMIC GROWTH IN CHINA*

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ABSTRACT. Land to accommodate urban development in China is provided through requisitions by government officials, suggesting that land availability may be a constraint on urban economic growth. An econometric model of urban GDP growth suggests that land has constrained economic growth in coastal areas but not elsewhere. Elasticities calculated from the estimated coefficients indicate that land availability has a larger proportional impact on economic growth than domestic and foreign investment, labor supply, and government spending. The estimated parameters provide evidence about arbitrage opportunities created by discrepancies between urban land value and compensation for requisitioned rural land, suggesting rural unrest associated with conversion of farmland to urban uses may have some economic roots.

1. INTRODUCTION

China has been urbanizing rapidly—as, indeed, one would expect in a country experiencing rapid industrialization and economic growth and especially as one would expect in a country whose historic policies left it significantly under-urbanized (Au and Henderson, 2006). But the rapid rate of urban land expansion has given China's central government considerable cause for concern because of the social disruptions (and consequent unrest in rural areas) due to rural residents' loss of land, because of potential threats to China's ability to ensure a secure food supply, and because the pace and scope of change threaten the central government's ability to control development (Cao, 2004; Lin and Ho, 2005; Deng et al., 2006; Lichtenberg and Ding, 2008). Empirical studies conducted to date have focused on demonstrating the association between economic growth and spatial expansion in urban areas with an emphasis on characterizing urban expansion as an outcome of economic growth (Seto and Kaufman, 2003; Deng et al., 2008). This paper looks at the opposite side of the coin: how urban spatial expansion influences economic growth in Chinese cities.

The role of land availability in urban economic growth has received much less attention than the role of land in economic growth and poverty alleviation in the rural sector,

*This paper is supported by funds from the Lincoln Institute of Land Policy. This paper is a part of collaboration between the Lincoln Institute of Land Policy and the Institute of China Land Survey and Planning at Ministry of Land and Resources, PRC. Juan Feng assisted in the collection and preparation of data. The authors are also grateful for Gregory K. Ingram, Ramon Lopez, and Lori Lynch for their comments and suggestions. Opinions and views expressed in this paper are solely those of the authors and not of the research sponsors. Responsibility for any errors rests with the authors.

Received: March 2009; revised: August 2009; accepted: December 2009.

 DOI: 10.1111/j.1467-9787.2010.00686.x

where it has been studied extensively with an emphasis on the role of property rights or, more specifically, security of tenure, in inducing investment in land and enhancing agricultural productivity more broadly (see for example Deninger, 2003).[1] Empirical studies of urban economic growth typically follow the general literature on growth by focusing on factors that are fixed in the short run—stocks of physical and human capital, the size of the labor force, and the state of technology (see for example Barro and Sala-i-Martin, 2004). They typically ignore land. The standard assumption in models of urban expansion is that land is available in perfectly elastic supply at a price equal to (a constant) agricultural rent, so that land adjusts frictionlessly to urban economic and population growth driven by other factors.

In China, land becomes available for urban expansion only via explicit decisions of government officials. These decisions are shaped by tensions between officials at different levels of government. Governance and fiscal reforms of the past two decades have placed municipal officials in the role played by land developers in Western countries; these officials have responded by requisitioning farmland for urban uses in order to promote economic growth and generate revenue to finance infrastructure and other needs (Lichtenberg and Ding, 2009). Concerns over food security, social unrest in the countryside resulting from land requisitions, and overinvestment in a number of industries have led the central government to attempt to reassert control over land development through a series of administrative controls on land requisitions.

Administrative controls imposed by the central may have kept local officials from providing sufficient land to meet demand generated by desired new investment. Efforts to rein in land conversion have been especially pronounced in areas where development pressure is high, raising the prospect that land availability has been a binding constraint on growth and thus that land has influenced growth in a manner similar to capital, labor force, and technology constraints. Efforts to slow limit farmland requisitions have been less pronounced in areas where development pressure is low; in these areas, land availability may not be a binding constraint and land will not have a significant influence on growth (so that traditional factors like capital accumulation and population growth will drive economic growth).

We investigate the extent to which administrative restrictions on land conversion have made land availability a constraint on economic growth. We proceed as follows. We begin with a review of the literature on determinants of economic growth in China, with an emphasis on urban growth (Section II). We then review the institutional and legal framework governing land allocation decisions in China, with particular attention to the incentives for land conversion created by fiscal and governance reforms of the 1990s (Section III). Section IV presents the data used in and specification of an econometric analysis factors influencing economic growth in the 220 largest Chinese cities from 1996 through 2003. The econometric results, discussed in Section V, indicate that the provision of land has had an effect on urban economic growth similar in magnitude to growth of the labor force and greater proportionally than either foreign direct or domestic investment, implying that land availability has indeed constituted a constraint on urban economic development in China and thus suggesting that municipal officials' land management policies have had a significant effect on China's economic growth.

[1]De Soto (2000) argues for the centrality of secure property rights in ensuring economic growth generally. Field (2007) shows that security of land tenure increases urban labor supply and thus household income in Peruvian squatter communities.

2. PREVIOUS LITERATURE

Empirical studies of economic growth in China as a whole and its urban sector in particular have examined the roles of expansion of productive factors (physical capital, human capital, labor, technology) that constrain output in the short run and institutional reforms that similarly relax constraints on productivity.

One strand of literature has been concerned with investment. A great deal of emphasis has been placed on the role of foreign direct investment (FDI), which is believed to be more productive than domestic investment because it introduces new technologies and new production methods that enhance human capital and because it induces host governments to make additional investments in infrastructure (Zhang and Zhou, 1998; Lin and Liu, 2001; Fujita and Hu, 2001; Zhang, 2001; Gao, 2003). Other studies have demonstrated the importance of investments in physical and institutional infrastructure and services provided by government (Démurger, 2001; Lin and Song, 2002).

Empirical studies of urbanization and urban economic growth in China have also focused on these factors together with sources of increasing returns that lead to geographic concentration of economic activity, notably agglomeration economies due to diversity in supplies of intermediate goods, labor market matching of skills, knowledge spillovers, and demand for variety (see for example Fujita and Thisse, 2002). A time-series analysis of urbanization levels in China over the period 1978–2000 conducted by Zhang (2002) attributes urban growth to economic growth generally, increases in employment opportunities in manufacturing and services, and FDI. A cross-section analysis of urban growth rates conducted by Lin and Song (2002) finds evidence that FDI, infrastructure investment, and investment in human capital contributed to per capita GDP growth in 189 Chinese cities over the period 1991–1998 while the effects of domestic investment and population growth were, if anything, negative. Anderson and Ge (2004) obtained similar results from a cross-section analysis comparing urban growth rates in 220 Chinese cities during the period 1990–1999. FDI was the main positive contributor to economic growth. Population growth contributed positively to total real GDP growth but negatively to growth in GDP per capita. The private sector was the main source of growth: Cities in which the state's share of the economy was smaller grew faster. A comparison of growth rates in these cities during the periods 1985–1990, 1985–1994, 1985–1999, and 1990–1999 suggested that FDI contributed more to growth during the early 1990s than later on. Conversely, the contribution of human capital accumulation appeared to have been increasing over time. Au and Henderson's (2006) cross-section analysis of economic growth rates in 205 Chinese cities during the period 1990–1997 found that total capital accumulation, FDI, and agglomeration economies due to population size and industry diversity were all significant sources of urban economic growth. They found in particular that Chinese cities had not exhausted economies of scale due to population size and were thus generally too small.

A second strand of literature has focused on the role of institutional reforms, notably decentralization of economic decision making and the fiscal system implemented during the 1990s. Beginning in the mid 1980s, China decentralized its fiscal system, substituting taxation for remittance of enterprise profits. At the same time, the central government devolved authority for investment decisions and growth management at the local level to local governments. Decentralization has the potential to foster greater economic growth because local officials may have better information about local needs, be more responsive to local demand for infrastructure and services, and provide greater support for local business development that central authorities might overlook (Zhang and Zhou, 1998; Lin and Liu, 2001; Jin, Qian, and Weingast, 2005). It can also induce local officials to improve performance in economic management by creating yardstick competition for

promotion opportunities and by transforming soft budget constraints into hard ones (Lin and Liu, 2001; Li and Zhou, 2005). Decentralization can also lead to worse economic performance, however, if it accommodates predatory local officials that stifle business development, results in overly burdensome taxation and regulatory policies, gives local governments free rein to establish trade barriers, or skews public expenditures toward providing services for local elites at the expense of productive investments in physical and human capital infrastructure (Bardhan and Mookherjee, 2000; Lin and Liu, 2001).

Empirical studies investigating the effects of decentralization on Chinese economic growth using provincial level data include a study by Lin and Liu (2001) using panel data for the period 1970–1993 and the ratio of provincial to total spending as measures of the degree of decentralization and one by Jin et al. (2005) using panel data for the period 1982–1992 and the ratio of revenue retained by the province as a measure of the degree of decentralization. Both found that decentralization increased the rate of economic growth at the provincial level.[2] Studies that have investigated the role of institutional reform in land on economic growth in China have focused exclusively on the rural, rather than urban sector. This literature has examined the effects of tenure security on investment in land quality, other agricultural improvements, and agricultural productivity generally (see for example Benjamin and Brandt, 2002; Jacoby et al., 2002; Deininger and Jin, 2003).

3. INSTITUTIONAL TENSIONS AFFECTING LAND ALLOCATION IN CHINA

The allocation of land for primary uses (urban versus agriculture) is in the hands of local municipal officials operating under conflicting imperatives of promoting economic growth and managing local government finances while preserving farmland. Decentralization reforms have given municipal officials a great deal of latitude in meeting these objectives, but those officials remain subject to regulatory limitations imposed by the central and provincial governments. In particular, regulatory restrictions on land conversion along with bureaucratic frictions encountered in obtaining relaxation of those restrictions may prevent the supply of land for urban uses from adjusting to demand for land to accommodate new commercial, industrial, and residential investment. When land supply lags behind demand, land availability will constrain economic growth.

China's system of land ownership places municipal officials in the position of land developers, that is, as agents providing land for investment in industry, commerce, and residential real estate. All land in China is publicly owned. Urban land is owned by the state while rural land is owned by village collectives. While some urban land is allocated directly to schools, infrastructure, and other public uses and some is controlled by state-owned enterprises under grants made primarily during the pre-reform period, the bulk of it is under the control of local officials who act as representatives of the state in managing land allocation, albeit subject to oversight by higher level officials at the higher levels of government (Ding, 2007). Private sector enterprises can utilize urban land under a system of long-term leases for use-rights. Lease terms are 40 years for commercial uses, 50 years for industrial uses, and 70 years for residential uses. Leases give private sector investors secure tenure and control over land during the lease term: Use-rights can be rented, sold, mortgaged, donated, and leased out (Ho and Lin, 2003; Ding and Song, 2005; Lin and Ho,

[2]Jin et al. (2005) also found that the results of an earlier study by Zhang and Zhou (1998), which found a negative relationship between decentralization and economic growth, were likely attributable to the influence of unobserved heterogeneity, since this negative relationship was reversed when fixed effects were introduced into the model.

2005). Use rights are acquired from the state by paying an up-front land conveyance fee to the appropriate local government. An annual rent is paid during the lease term.

Farmland is the principal source of land for urban expansion.[3] During 2000–2001, for example, three quarters of the land used for urban expansion was obtained through farmland acquisition while over half of urban construction occurred on converted farmland (Investigating Group of Land Acquisition Reform of Ministry of Land and Resources, 2003). Rural land belongs to and is administered by village collectives, again subject to oversight by higher level government bodies. These village collectives have authority to allocate land for limited kinds of housing, public works, and village enterprises in addition to agriculture. They do not have authority to allocate land for most forms of industrial or commercial development; in fact, allocation of rural land for these uses is expressly prohibited. Allocation of rural land for industrial or commercial use thus only becomes possible when ownership is transferred from the collective to the state. In other words, development of land for most residential, commercial, and industrial uses is allowed only after a change in ownership status, accomplished by a requisition of rural land by urban government officials.

Acquisition of land to accommodate new investment and permit economic growth, then, requires converting land from rural to urban status. The first step involved is a process of requisition in which ownership is changed from collective to state land. Compensation is required. Since there are no markets for rural land, the Land Administration Law established an administrative formula for determining compensation for farmers whose land is requisitioned. The compensation package is based largely on agricultural productivity and includes payments for land, crops currently under cultivation, attachments to land, and land improvements plus subsidies for resettlement.

The requisition process is structured in a way that lets local governments capture the rents from converting rural land to urban use. Because it is based on agricultural productivity, compensation for rural land tends to be much lower than the conveyance fees local governments receive as up-front payments for use-right leases, at least in rapidly growing urban areas. Anecdotal evidence suggests that conveyance fees are frequently 10–20 times farmland compensation. For example, land compensation and resettlement subsidies in the Jianggan district of Hangzhou were 120,000 Renminbi (RMB) per mu[4] from 1997 to 1999 and 160,000 RMB per mu after 1999, compared to conveyance fees for land use rights for housing projects averaging two to four million RMB per mu (Xu, 2003). In 1992, the Pudong Development Commission paid farmers 20,000 RMB per mu and then resold the land to developers and investors for at least 300,000 RMB per mu (Chen, 2002). In one village in Fujian province, the local government paid about 10,000 RMB per mu to farmers for land that was subsequently leased to private sector developers in return for conveyance fees for 200,000 RMB per mu if zoned industrial and over 750,000 RMB per mu if zoned residential (Investigating Group of Land Acquisition Reform of Ministry of Land and Resources, 2003).

Profits from land transactions have become a significant source of revenue for local governments that have few alternative fiscal instruments, especially in the wake of fiscal and tax reforms introduced in the early 1990s (Ding, 2007; Lin, 2007). Prior to that time, local governments ran small but persistent budget surpluses while the central government

[3]Urban development is subject to rigorous urban planning that limits density by restricting allowable floor area ratios. Substitution of capital for land is thus highly limited in China (Bertaud, 2007). Redevelopment of existing urban land is frequently infeasible because land is controlled by former state-owned enterprises under previous grants; when it is feasible, it tends to be quite expensive because existing tenants must be resettled and compensated at local government expense (Fu et al., 1999; Lin, 2007).

[4]A unit of land area equal to about 1/15 hectare.

ran small but persistent deficits. The reforms of the early 1990s increased the central government's tax revenues at the expense of provincial and local governments. They did not, however, alter local governments' expenditure obligations nor did they lessen the pressure on local governments to invest in infrastructure and otherwise promote economic growth (Wong and Bhattasali, 2003; Zhang and Martinex-Vazquez, 2003). As a result, provincial and local governments have experienced large and growing fiscal deficits while the central government has experienced large and growing surpluses (Xie et al., 2005).

Land transactions are one of the few fiscal instruments available for closing local government deficits and funding investments in infrastructure in rapidly growing parts of China. The result is that in China as a whole land-related revenue grew from less than 10 percent of total budgetary (that is, tax) revenue in 1999 to 55 percent of budgetary revenue in 2003–2004 (Table 1).[5] In 2003, for instance, revenues based on land transactions amounted to $154 billion, compared to total tax revenues of $292 billion for all levels of governments. Land generated 26 percent more revenue than taxes (net of revenue sharing from the central government) for governments at the provincial, prefectural, and local levels.[6]

The emergence of land transactions as a major source of local government revenue was especially pronounced in Eastern China, most notably in Jiangsu and Zhejiang Provinces and the provincial-level cities Beijing and Tianjin, and in Chongqing and Sichuan Provinces in Western China, where land-related revenues were on a par—and sometimes exceeded—budgetary revenues. In many jurisdictions, land conveyance fees account for as much as 80–100 percent of the funds needed to finance urban infrastructure that helps to promote urban expansion (Yang and Wu, 1996; Liu, 2005). For instance, in 2004, 51 percent of urban infrastructure construction was financed out of land revenues in Jihua city of Zhejiang Province. Local governments have also used land as collateral for loans to finance urban infrastructure (Ding, 2007).

Institutional and fiscal reforms have strengthened the incentives for local officials to convert land from rural to urban uses in order to accommodate economic growth and improve fiscal performance. But that process has created a number of problems. Urban expansion into the countryside has created problems ranging from traffic congestion and pollution due to urban sprawl to social unrest in rural villages and central government concerns about food security due to farmland loss (Lichtenberg and Ding, 2008). There are also some indications that the profitability of land development has led to some speculative activity on the part of local officials that has resulted in wasteful land conversion. Newlycreated economic development zones have been popular means of attempting to use land to spur investment for local officials and for the provincial and state-level officials overseeing them. Not all of these efforts have met with success. By 1996, there were roughly 116,000 hectares of idle undeveloped land in economic development zones, mainly located in less-developed regions where demand was not present (Cai, 2003; Ho and Lin, 2004). In 2004, China's Ministry of Land and Resources found that 70 percent of the 6,866 locations set aside for industrial or economic development zones contained land that was either acquired illegally or remained vacant. Over 13 million hectares—almost 65 percent of the land planned for these development zones—was ordered returned to agricultural use, among which majority was in less-developed regions where demand was not present (Cao, 2004; Lin, 2007).

[5]Profits from land development are counted as extrabudgetary revenue and are thus not included in official budgetary revenue statistics.

[6]Source: http://tjsj.baidu.com/pages/jxyd/27/69/deaeeea93dbe720d062aa46490f5b284_0.html.

TABLE 1: Ratio of Land Revenue to Total Budgetary Revenue by Province, 1999–2005

	Year						
Region	1999	2000	2001	2002	2003	2004	2005
Total China	*6.90*	*9.30*	*16.61*	*28.38*	*55.04*	*42.16*	*39.53*
Coastal Provinces	11.89	11.41	20.18	33.59	63.55	60.49	42.29
Beijing	30.50	20.74	26.37	25.42	55.44	84.80	10.77
Tianjin	12.65	5.83	10.52	15.53	102.44	170.47	38.71
Shanghai	10.23	7.18	13.67	18.09	33.20	44.49	27.50
Hebei	8.21	8.58	21.07	40.26	45.13	47.08	32.18
Liaoning	6.01	7.17	19.22	25.98	40.62	51.63	39.97
Jiangsu	12.88	18.24	37.76	70.62	120.19	68.79	76.16
Zhejiang	15.12	34.36	48.57	81.55	165.68	108.48	75.60
Fujian	6.02	13.99	15.78	36.50	54.66	61.26	55.52
Shandong	3.09	4.93	6.57	29.22	56.07	54.19	46.46
Guangdong	18.08	7.16	12.53	11.17	16.50	16.85	19.55
Guangxi	6.58	6.00	9.26	16.51	32.54	54.76	29.89
Hainan	8.09	0.52	17.30	15.29	14.63	15.53	41.94
Central Provinces	*2.63*	*3.42*	*7.83*	*17.51*	*29.51*	*33.81*	*26.33*
Shanxi	1.29	2.54	4.03	17.91	24.70	18.66	13.30
Inner Mongolia	1.58	2.45	4.87	8.83	9.53	13.79	18.61
Jilin	3.73	5.73	11.44	14.69	22.20	24.78	28.24
Heilongjiang	1.78	2.42	2.33	6.51	15.54	16.02	13.60
Henan	2.64	5.18	6.88	12.07	22.91	28.30	23.83
Hubei	1.97	0.35	9.09	20.61	54.75	63.27	43.74
Hunan	5.01	5.45	15.16	37.81	44.17	57.78	40.02
Anhui	3.57	5.84	13.89	33.75	79.32	83.89	65.16
Jiangxi	2.72	3.39	18.16	42.69	52.29	61.76	59.69
Western Provinces	*5.29*	*6.37*	*8.28*	*14.27*	*40.93*	*51.70*	*41.49*
Chongqing	10.52	4.02	9.43	24.16	55.38	76.91	62.77
Sichuan	8.24	23.21	11.99	22.79	76.18	93.50	82.19
Guizhou	3.36	6.63	7.90	10.16	16.34	19.10	18.63
Yunnan	3.44	4.59	5.12	7.15	30.21	28.60	22.84
Tibet	1.10	0.94	0.86	7.78	8.72	19.09	38.36
Shaanxi	4.44	4.39	10.03	10.66	24.46	52.73	24.33
Gansu	2.87	2.19	3.07	9.00	14.14	14.75	15.35
Qinghai	0.80	4.27	5.43	12.24	7.43	8.29	10.02
Ningxia	3.00	10.19	3.17	7.27	53.88	53.31	28.84
Xinjiang	2.43	4.42	7.01	9.13	19.62	18.53	11.90

Source: China Land Resource Yearbooks, 2000–2006.

The central government has also been concerned about overinvestment in a number of industries resulting from competition among local governments. Sectors already exhibiting excess capacity include steel, with current production capacity estimated at 470 million tons and planned capacity of an additional 130 million tons compared to a demand of only 370 million tons, and automobiles, with almost 50 percent more capacity than estimated market absorption. Other industries with excess capacity include aluminum, ferroalloys, coke, calcium carbide, automobile, copper, cement, electric power, coal, textiles, petrochemicals, paper boxes, chemical fertilizers, domestic electric appliances, micro-computers, and shipbuilding.[7]

[7]Sources: http://www.dq.shejis.com/new_info/html/69805.shtml. http://www.fubusi.com/2006/2-23/155749909.html.

Alarmed over the rapid rate at which agricultural land was being requisitioned for urban uses, especially in the fast-growing coastal areas that contain the most productive farmland (and have experienced the most social unrest in the countryside), the central government imposed strict administrative controls designed to protect farmland and slow down land conversion (Lichtenberg and Ding, 2008); the discovery of idle land in enterprise zones and the emergence of excess capacity in numerous industries have led the central government to tighten those controls. The 1998 Land Administration Law imposed limits on farmland conversion in two major ways. First, each jurisdiction was required to designate a fixed share of its agricultural land as basic farmland whose conversion into urban uses is prohibited without explicit permission or approval from the state council. Second, the Law imposed the so-called dynamic balance (no net loss) policy, which requires that any conversion of farmland to urban uses be exactly offset by conversion or reclamation of other land to agricultural use. These measures are implemented via a process in which governments of provinces, cities, counties, and townships develop land use plans documenting farmland protection targets, land conversion quotas, and amounts and locations of land that will be designated as basic farmland. Land use planning is constructed in a hierarchical fashion as a means of exerting strong vertical control in land management. Land use plans at each administrative level are required to be developed in accordance with plans at the next higher administrative level and must be approved by the next higher administrative level (i.e., municipal land use plans must be approved by provincial governments while provincial land use plans must be approved by the State Council). This process creates vertical allocation of land development and conversion quotas. Land conversion quotas and administrative oversight were tightened in 2004.

The effect of this process of hierarchical control over land conversion varies according to economic development status, development pressure, the intensity of human activity, and natural land endowments. Areas like China's coastal provinces that have been experiencing high levels of economic growth (and correspondingly high levels of development pressure) but also have the most productive farmland tend to be subject to tighter hierarchical control over land conversion. Areas like China's western provinces that have been experiencing much less economic growth (and correspondingly lower development pressure) and have relatively poor farmland tend to be subject to much less stringent control over land conversion. Thus, coastal China is likely to experience constraints imposed by restrictions on the supply of land for urban growth while western China is not.

In sum, decentralization of economic decision making and fiscal reforms of the past two decades have given local officials incentives to convert land from rural to urban uses at rapid, and at times excessive, rates. The central government has attempted to reassert greater control over primary land allocation by imposing restrictions on land conversion. In some instances, these restrictions may have kept the supply of land below levels needed to accommodate demand for new investment; in those instances, land availability has served as a constraint on economic growth.

4. DATA AND MODEL SPECIFICATION

Following Ciccone and Hall (1996) and Dekle and Eaton (1999), we investigate the extent to which land availability has constrained economic growth in China by estimating the direct effects of land on economic growth using a standard production function that includes land as an input. In contrast to previous studies, we use panel data rather than a simple cross section of cities. We posit output in city j at time t (Y_{jt}) as a function of land

(L_{jt}), labor (N_{jt}), capital (K_{jt}), infrastructure and government-provided services (G_{jt}), and other (unobserved) factors unique to each city (A_j) and time period (u_t):

$$Y_{jt} = F(L_{jt}, N_{jt}, K_{jt}, G_{jt}, A_j, u_t). \tag{1}$$

Since we were able to obtain information on investment flows but not on stocks of capital, we use a first-difference formulation of Equation (1):

$$\begin{aligned} Y_{j,t+1} - Y_{tt} = {} & F_L(L_{j,t+1} - L_{jt}) + F_N(N_{j,t+1} - N_{jt}) \\ & + F_K(K_{j,t+1} - K_{jt}) + F_G(G_{j,t+1} - G_{jt}) + u_t + e_{jt}. \end{aligned}$$

Here, subscripts of the production function $F(\cdot)$ represent derivatives.

We estimate the parameters of this model using panel data on 220 major Chinese cities during the period 1996–2003, a total of 1,540 observations. We focus on the time period beginning in 1996, the first year in which reliable land use data are available. We obtained data from two sources. Data on urbanized land area in each city, reported in mu, came from the records of Ministry of Land and Resources (MLR), which document land conversion between urban and nonurban areas in detail. Economic and demographic data come from City Statistical Yearbooks for the years 1997–2004 (containing data for the years 1996–2003). The latter included information on GDP in total and by sector (primary, secondary, and tertiary), reported in RMB 10,000; population (total, agricultural, and nonagricultural) in each year, measured in 10,000 persons; total investment in fixed assets, reported in RMB 10,000; realized FDI, measured in U.S.$10,000;[8] and government expenditures, reported in RMB 10,000. Land area is converted to hectares at a rate of 15 mu per hectare. Monetary measures are converted from RMB to U.S. dollars at a rate of 8 RMB per dollar. All monetary values are corrected for inflation to constant 2005 levels using the fixed price consumer price index reported by China's National Bureau of Statistics (2006). Missing observations of government expenditures and revenues reduce the sample size to 1,494. Descriptive statistics of the sample used in the analysis are given in Table 2.

We use GDP in secondary and tertiary industry to measure urban economic output, hence the estimated coefficients equal the marginal values of the inputs included as independent variables. As noted above, industrial and commercial development is severely restricted in rural areas, so the overwhelming majority of secondary and tertiary GDP is generated in cities. We use the size of the nonagricultural population as a proxy for the size of the labor force since reliable employment data were not available for the entire sample period. We expect the coefficient of this variable to equal the marginal value added per worker. We use government expenditure as a measure of current investment in infrastructure and provision of government services that support economic activity. Since this variable also includes social spending in addition to physical and institutional infrastructure provision, its coefficient should be less than the marginal rate of return to infrastructure. The coefficients of land and investment in fixed assets should equal the marginal value of urban land and rate of return on physical capital stocks, respectively, which should exceed the corresponding net or rental values of these inputs. The coefficient of FDI should equal the rate of return of physical capital, new technologies, and human capital provided by FDI (Zhang, 2001).

The relative impacts of domestic and FDI are of special interest. FDI is widely believed to have played a dominant role in China's economic growth. Given its weak domestic

[8]Foreign direct investment was not reported for all (especially earlier) years in some cities. Visual examination of the data showed that foreign direct investment in these cases was quite small in subsequent years, hence foreign direct investment was set to zero whenever it was not reported.

TABLE 2: Descriptive Statistics of the Data Used in the Model of Nonagricultural GDP Growth in 220 Major Chinese Cities

	National		Coastal Provinces		Central Provinces		Western Provinces	
Variable	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Urban GDP	287767.3	581763.5	405083.2	772410.1	169359.7	247566.5	191869.1	280813.7
Urban land	4739.774	4994.828	5039.09	5459.147	4473.878	4432.077	4399.131	4654.108
Domestic investment	109367.5	253557	153381.8	339533.4	61878.53	97733.65	81513.29	134686.8
Foreign direct investment	19443.3	54576.3	34183.78	73263.51	4950.55	13866.41	3960.986	7569.245
Nonagricultural population	75.94933	105.4138	87.00004	132.5352	63.31291	62.22507	70.84675	83.48371
Government expenditure	29133.95	84656.43	43425.55	116975.8	14136.61	18808.76	18969.64	33009.19
Urban GDP per hectare urban land	60.01818	65.17125	79.59116	83.18958	40.58123	30.80559	43.17506	32.43839
Agricultural GDP per hectare cropland	0.28505	0.319314	0.365478	0.389798	0.208883	0.196512	0.206025	0.227489
Government revenue per hectare urban land	22793.98	69913.82	35100.48	96969.81	9901.273	14203.09	13984.45	22733.58
Number of observations	1494		732		551		211	

GDP, investment, government expenditure, and government revenue in $10,000 evaluated at constant 2005 prices using China's consumer price index and an exchange rate of 8 RMB per dollar.

demand, international trade has been China's main engine of growth. FDI has directly or indirectly been responsible for almost all of China's export growth since 1992 (Wei, 1995, 1996; OECD, 2000). In addition to providing investment funding, FDI is widely believed to generate spillover effects due to the introduction of new technologies, enhancement of human capital from exposure to more advanced production methods, changes in industry structure due to increased competition, and institutional and infrastructure improvements required to maintain inflows of foreign capital (OECD, 2000). Previous econometric studies have found that the rate of return on FDI is substantially greater than the rate of return on domestic investment (Démurger, 2001; Zhang, 2001; Lin and Song, 2002; Anderson and Ge, 2004).

Land is an input into production and might thus be correlated with unobserved factors influencing output (i.e., might be endogenous). We examine this possibility using a Hausman test. Following Lichtenberg and Ding (2009), we use the average real value of urban land (proxied by real urban GDP divided by urban land area), the average real value of agricultural land (proxied by real agricultural GDP divided by cropland area, real budgetary government revenue, all calculated at time t and thus effectively lagged one period, plus city-specific fixed effects as instruments for the change in urban land area.[9] Hausman tests indicate the presence of correlation between changes in land and unobserved factors influencing changes in real urban GDP (the t-statistics were -4.55 and -4.00 for models with year-specific random and fixed effects, respectively), so we estimate the model using the IV panel data routine in Stata using the real average value of urban land, real per capita agricultural GDP, real budgetary government revenues, and city-specific fixed effects as instruments.[10] A standard test of overidentifying restrictions (Wooldridge, 2002, pp. 122–124) indicates that these instruments are uncorrelated with changes in real urban GDP (the respective χ^2 test statistics for models with year-specific random and fixed effects are 1.49 and 1.64 with 223 degrees of freedom, corresponding to P-values of 1.00). A Hausman test indicates that the hypothesis of no correlation between unobserved year-specific variables and the independent variables included in the model cannot be rejected (the test statistic is -4.09 with five degrees of freedom), so we use year-specific random effects. Models with year-specific fixed effects give virtually identical results.

We also estimate separate models for coastal, central, and western China to investigate differences in the productivity of urban land in areas experiencing markedly different rates of economic growth and pressure on land availability. Coastal China (comprising the provincial level cities Beijing, Tianjin, and Shanghai and Hebei, Liaoning, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Guangxi, and Hainan Provinces) has been experiencing very rapid economic growth. Central China (comprising Shanxi, Inner Mongolia, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, and Hunan Provinces) has been experiencing less-rapid economic growth. Western China (comprising Chongqing, Sichuan, Guizhou, Yunnan, Xizang, Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang Provinces)

[9]Lichtenberg and Ding (2009) present a formal model of local officials' use of land conversion to meet objectives of promoting economic growth and sound fiscal management. The model implies that the rate of land conversion is increasing in the value of urban land and expected future tax receipts from urban land and decreasing in the value of agricultural land. They provide econometric evidence that local officials do respond to those incentives in the manner expected. Budgetary revenues include government income from various taxes but not income from land transactions or user fees and thus, serve as a proxy for expected future tax revenues from land conversion.

[10]A regression of the change in urban land area on these instruments had an R^2 of 0.30 and the coefficients of urban land value, agricultural land value, and government revenues were all significantly different from zero at a 1 percent significance level.

TABLE 3: Urban Spatial Expansion by Region and Province, 1996–2003

Province	Urban Area (Hectares) in: 1996	2003	Annual Growth Rate	Average Annual Change in Urban Area (Hectares)
Coastal Provinces				
Beijing	23,209	28,196	2.8%	713
Fujian	18,154	24,011	4.1%	837
Guangdong	92,502	121,770	4.0%	4,181
Hainan	5,227	5,823	1.6%	85
Hebei	48,849	55,927	2.0%	1,011
Jiangsu	41,250	50,456	2.9%	1,315
Liaoning	104,049	115,895	1.6%	1,692
Shandong	74,043	90,745	2.9%	2,386
Shanghai	27,881	28,827	0.5%	135
Tianjian	20,251	20,924	0.5%	96
Zhejiang	19,563	31,716	7.1%	1,736
Regional total	*474,979*	*574,290*	*2.7%*	*14,187*
Central Provinces				
Anhui	31,536	38,693	3.0%	1,022
Heilongjiang	93,435	98,786	0.8%	764
Henan	44,706	60,063	4.3%	2,194
Hubei	43,791	51,494	2.3%	1,100
Hunan	26,579	41,949	6.7%	2,196
Inner Mongolia	26,984	28,091	0.6%	158
Jiangxi	11,199	12,484	1.6%	184
Jilin	33,129	34,588	0.6%	208
Shanxi	12,128	18,156	5.9%	861
Regional total	*323,488*	*384,305*	*2.5%*	*8,688*
Western Provinces				
Chongqing	9,436	21,232	12.3%	1,685
Guizhou	5,072	6,358	3.3%	184
Gansu	21,918	23,625	1.1%	244
Ningxia	7,011	10,716	6.2%	529
Qinghai	3,304	3,605	1.3%	43
Shaanxi	23,623	29,518	3.2%	842
Sichuan	29,294	53,770	9.1%	3,497
Xinjiang	13,451	13,186	−0.3%	(38)
Yunnan	3,500	7,033	10.5%	505
Regional total	*116,610*	*169,043*	*5.4%*	*7,491*
Total China	***915,076***	***1,127,639***	***3.0%***	***30,366***

has been experiencing the least economic growth overall. Average annual growth rates of urban area over our sample period were similar in relative terms in all three regions but there are substantial differences in the likelihood that land availability constituted a binding constraint on economic growth (Table 3).

Pressure on land availability is by far the greatest in the coastal provinces, which account for 47 percent of total urban land expansion in the cities in our sample during our sample period (Table 3). This region contains only 14 percent of the total land area of China but, as of 2003, 29 percent of China's cropland, indicating that land is used more intensively for agriculture in this region than elsewhere in China. This region accounted for 62 percent of China's GDP, 65 percent of its industrial output, and 42 percent of

China's population. This region contains the most productive farmland in China has seen the greatest social unrest over land conversion, and contains much of the excess industrial capacity in the country; as a result, central government efforts to rein in land conversion have been pursued the most zealously in that region. These considerations lead us to expect that land availability is more likely to have been a constraint on economic growth in this region than elsewhere in China.

Pressure on land availability appears to be the least in western China, which accounts for about a quarter of urban land expansion in the cities in our sample during our sample period. This region contained 57 percent of China's total land area but only 28 percent of its cropland. It accounted for only 13 percent of China's GDP, 11 percent of its industrial output, and 23 percent of its population. Western China has experienced slower economic growth than elsewhere in China, so that demand for farmland conversion has been lower, while agricultural productivity is poor so that the central government has been less concerned with protecting farmland. These considerations suggest that land is likely plentiful relative to desired uses hence that land availability is less likely to be a constraint on economic growth in this region than elsewhere in China.

Pressure on land availability in central China, which accounts for 29 percent of urban land expansion in the cities in our sample during 1996–2003, appears to be greater than in western China but substantially less than in coastal China. This region contained 30 percent of China's total land area and 43 percent of its cropland, indicating that land is used more intensively for agriculture here than in western China but less so than in coastal China. This region accounts for a quarter of China's GDP, a quarter of its industrial output, and 35 percent of its population. Economic growth has been substantially slower than in the East but greater than in the West, while agricultural productivity is substantially greater than in the West but again lower than in the East. These considerations suggest that land is more likely to be a constraint on economic growth in this region than in western China but less likely to be so than in the coastal provinces. As noted above, idle land in industrial and economic development zones has been located largely in Western and Central China.

5. RESULTS

The estimated parameters of all four models are given in Table 4. Overall, the models fit the data well. Almost all of the coefficients are significantly different from zero and have the expected signs, both for China as a whole and for the three regions. The relative magnitudes of the estimated coefficients are in accord with previous literature and other information as well.

The Impact of Land Availability on Urban Economic Growth

The coefficient of urban land in the national model is significantly different from zero (Table 3). The regionally disaggregated models indicate that land has influenced urban economic growth only in China's fast-growing coastal provinces, however: The coefficient of urban land is not significantly different from zero in either the central or western provinces. The marginal value of land, as measured by the coefficient of urban land area, is about $108,000 per hectare. All of that value is attributable to the coastal provinces, where the marginal value of land averages about $370,000 per hectare, compared to a marginal value of essentially zero in central and western China.

How important has land availability been in urban economic growth in China? We estimate elasticities (evaluated at sample and subsample means) in order to compare the effects of land, labor, capital, and government expenditures on output (Table 5). For

TABLE 4: Estimated Coefficients of Year-Specific Random Effects IV Regression Models of Urban GDP Growth in 220 Major Chinese Cities

Variable	National	Coastal Provinces	Central Provinces	Western Provinces
Urban land	10.77792**	37.02745***	−2.17488	−1.62462
	(4.500154)	(12.19603)	4.213795	5.44233
Domestic investment	0.1480857***	0.150115***	0.151541***	0.169189***
	(0.0147452)	(0.0248869)	0.0242463	0.0189413
Foreign direct investment	0.4228087***	0.378006***	−0.18169	0.73064
	(0.0425857)	(0.0673738)	(0.1281521)	(0.305654)**
Nonagricultural population	1234.262***	1322.796***	1770.388***	1612.84***
	(98.15253)	(152.5736)	(344.1637)	(252.4598)
Government expenditure	0.1640971***	0.159263**	0.699343***	0.022025
	(0.0435408)	(0.0707061)	(0.12977)	(0.0582666)
R^2	0.7642	0.7421	0.5934	0.8115
N	1494	732	551	211

GDP, investment, and government expenditures in $U.S. 10,000 evaluated at constant 2005 prices using China's consumer price index and an exchange rate of 8 RMB per dollar. Urban land in hectares. Population in 10,000 persons.

***Denotes significantly different from zero at a 1 percent significance level.

**Denotes significantly different from zero at a 5 percent significance level.

Asymptotic standard errors in parentheses.

TABLE 5: Elasticities of GDP with Respect to Selected Variables

Variable	National	Coastal Provinces	Central Provinces	Western Provinces
Urban land	0.178	0.461		
Domestic investment	0.056	0.057	0.055	0.0729
Foreign direct investment	0.029	0.032		0.015
Nonagricultural population	0.326			0.596
Government expenditure	0.017	0.017	0.058	

Elasticities calculated at sample and subsample means for variables with estimated coefficients significantly different from zero.

China as a whole, the elasticity of urban GDP with respect to land is exceeded only by the elasticity of GDP with respect to labor: A 1 percent increase in land increases urban GDP by more than three times as much as a 1 percent increase in domestic investment, more than six times as much as a 1 percent increase in FDI, and more than 10 times as much as a 1 percent increase in government expenditures. In coastal China, the elasticity of urban GDP with respect to land is greater than that of any other factor of production: A 1 percent increase in land increases urban GDP by more than eight times as much as a 1 percent increase in domestic investment, more than 14 times as much as a 1 percent increase in FDI, almost 27 times as much as a 1 percent increase in government expenditures, and 1.6 times as much as a 1 percent increase in labor supply.

These results suggest that land availability has, in fact, been a constraint on economic growth in China, albeit primarily in the fast-growing coastal provinces. That interpretation suggests further that relaxation of constraints on land availability accomplished through requisitions of rural land has been an important contributor to economic growth in China's coastal provinces. In other words, land is as much a cause of economic growth as an effect of economic growth. From this perspective, these results provide

additional substance to previous work on the influence of decentralization reforms on economic growth in China: One important way these reforms have fostered economic growth has been to give local officials the means and incentive to provide land for business development directly and for infrastructure that supports business development indirectly.[11]

The lack of statistical significance in the estimated coefficients of land in central and western China is that land availability has simply not been a constraint on economic growth in those regions. As the figures cited above suggest, land has been relatively plentiful relative to both urban and rural uses in these regions. Also as noted above, urban economic activity and growth are lower here than in the coastal provinces and cropland takes up smaller shares of total land area. The results of our econometric analysis suggest that requisitions of rural land by municipal governments in these regions have been more than adequate to accommodate urban economic growth so that growth rates are determined by relaxation of constraints on physical capital and labor force size rather than land.

A further possibility, consistent with the negative signs of these coefficients, is that municipal governments in these regions have engaged in excessive speculative land conversion, requisitioning rural land, and setting it aside in economic development zones in the (vain) hope that by setting land aside investment would follow. As noted above, speculative land conversion of this kind has been substantial. This explanation seems most pertinent for cities located in central Chinese provinces like Henan, Hunan, Hubei, and Anhui, where, as the figures in Table 3 indicate, urban spatial expansion has been large in absolute and relative terms.

The estimated marginal value of urban land derived from the econometric model reported in the preceding section provides additional supporting evidence regarding land conversion as a source of local government revenue. The marginal value of land implied by the regression coefficients for the full sample is almost 37 times the average per hectare value of agricultural output in China as a whole, approximately $2,950 in 2004. Since the formulas governing compensation for requisitioned agricultural land specify compensation on the order of 6–10 times average agricultural output value, this disparity suggests that profits from land conversion are substantial. This disparity is especially pronounced in coastal China, where the marginal value of urban land implied by the regression coefficients for Eastern China is almost 90 times the $4,227 average per hectare value of agricultural output in that region in 2004. These large disparities between the value of urban land and compensation for requisitioned rural land are consistent with data from several localities (Chen, 2002; Investigating Group of Land Acquisition Reform of Ministry of Land and Resources, 2003; Xu, 2003).

The evidence provided by our econometric model, along with the anecdotal evidence cited above, suggests that restrictions on commercial and industrial development by rural villages are an important source of friction (and social unrest) due to conversion of rural land to urban uses. All of this evidence indicates that the profits from land development are extremely large, at least in coastal China. Current rules governing primary land allocation give municipal governments rather than rural villagers the right to appropriate those profits. Loosening restrictions on commercial and industrial development by rural villages could well lessen tension over land conversion by giving villagers the opportunity to profit from land development.

[11] Another implication of this finding is that econometric studies should take into account the endogeneity of land when considering economic growth as a determinant of urban expansion.

Estimated Rates of Return to Capital, Infrastructure, and Labor

The coefficients of domestic investment in fixed assets and FDI are both positive and significantly different from zero. The rate of return on domestic investment is about 15 percent for the sample as a whole and for all three regions.

The rate of return on FDI is much higher, about 42 percent for the sample as a whole. In the regional subsample models, the coefficient of FDI is significantly different from zero in coastal China, where the implied rate of return is about 38 percent, and western China, where the implied rate of return is over 73 percent. As noted above, FDI is widely believed to generate greater returns than domestic investment due to spillover effects from new technologies, increased human capital, increased competition, and induced institutional and infrastructure improvements. These results support that notion overall. They indicate that these spillover effects are significant in magnitude: The rate of return on FDI is over four times the rate of return on domestic investment for all of China during the entire sample period, a finding consistent with those of previous studies (Démurger, 2001; Zhang, 2001; Lin and Song, 2002; Anderson and Ge, 2004).

The coefficient of government spending is also significantly different from zero and implies a rate of return of about 16 percent, suggesting that productive investment in physical and institutional infrastructure accounts for a significant share of government spending. Again, there are substantial differences across regions. Government spending contributed the most to economic growth in central China, where the coefficient of government expenditure suggests a rate of return of about 70 percent. The effect of government spending on urban economic growth in coastal China was about equal to the national average of 16 percent. The productivity of government spending in western Chinese cities was much lower, only about 2 percent, suggesting that the share of government expenditure attributable to investment in physical and institutional infrastructure has been far lower in that region than elsewhere in China.

The coefficient of nonagricultural population, also significantly different from zero, indicates marginal value-added of $1,234 per person, slightly lower than the average wage of $1,517 per person in all of China in 2005. The productivity of labor is highest in central ($1,770 per person) China and lowest in coastal China ($1,323 per person), with western China in between ($1,613 per person), suggesting that growth in coastal Chinese cities during this period attracted sufficient labor from elsewhere in China to keep labor productivity low at the margin.

6. FINAL REMARKS

Land in China is rapidly being converted from rural to urban uses as China modernizes and urbanizes. Because of the institutional structure governing the primary allocation of land between rural and urban uses, decentralization reforms have placed local officials in the role played by land developers in market economies. Land is needed to accommodate economic growth, and some officials may act on the belief that provision of land acts as an inducement for additional investment. Following the fiscal reforms of the mid 1990s, profits from land conversion have become important sources of local government revenue. Land development is an integral part of local officials' management of economic growth overall and thus a central mechanism through which decentralization reforms operate on economic growth. The result has been conversion of farmland to urban uses at a rapid pace, at least in the areas experiencing significant economic growth.

That rapid growth has created a number of problems, however, most notably concerns over food security, over social unrest in the countryside created by requisitions of farmland, and over the emergence of excess capacity in many industries. In response, the central government has attempted to reassert control over land allocation by imposing

administrative controls limiting the rate of farmland conversion and strengthening its oversight over land transactions.

This paper examines the role of land in urban economic growth. We do so by investigating the effects of land on economic growth with an econometric model applied to data from the 220 largest Chinese cities for the period 1996–2003. The model provides empirical evidence of the importance of land conversion in urban economic growth in China. The importance of land supply in urban economic growth is especially pronounced in coastal cities. Elasticities calculated from the estimated coefficients indicate that a 1 percent increase in land availability is associated with a much larger proportional increase in economic output in coastal cities than a similar increase in domestic investment, FDI, labor supply, or government spending. The estimated value created by urban land in this region is substantial, suggesting that land development constitutes an important part of the management of economic growth in major Chinese cities and thus an important means through which decentralization reforms have fostered economic growth in China's urban sector. In contrast, urban economic growth is not affected by land availability in central and western regions. Taken together, these results suggest that land management will be more efficient if it tailored to reflect regional differences—unlike the current policy, which imposes nationally uniform farmland protection requirements.

The estimated parameters provide additional, systematic evidence about the arbitrage opportunities created by discrepancies between urban land value and compensation required for requisitioned rural land. Conversion of rural land to urban uses has generated unrest in China's countryside and unease in its centers of power. Our results indicate that conversion of rural land to urban uses has been an important determinant of economic growth in China's coastal provinces, so that farmland loss has not been in vain. Those results also provide evidence confirming some of the economic roots of that rural unrest: Conversion of farmland to urban uses is extremely profitable but China's land allocation system guarantees those profits to municipal governments and urban investors, shutting out current owners of rural land. Granting the right to develop land for commercial and industrial uses to rural villages could help alleviate that unrest.

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