Chapter 1
Government Land Use Interventions: An Economic Analysis

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Government interventions affect land use outcomes in cities around the world. These interventions are often well meaning, being designed to achieve ends that are thought to be socially desirable. However, since urban real estate markets are complex systems, land use interventions often generate subsidiary effects that are unanticipated by policy makers. These effects can be undesirable, offsetting the benefits that the interventions were intended to capture. The result can then be a net social loss, so that the land use intervention leaves the urban economy in a worse position than where it started.

The notion that land use interventions can be counterproductive has been a theme of World Bank research for several decades. This chapter offers another installment in this line of thinking. The chapter presents no new theories or new evidence. Instead, it offers an overview of the economics of land use interventions by combining a number of diverse elements from existing research into a single package. The aim is to help provide insights into land use interventions that would otherwise require synthesizing material and ideas from a wide variety of sources.

1.1 A Typology of Land Use Interventions

Urban economists and researchers have studied government land use interventions in many countries around the world. This section surveys the interventions considered in these studies, providing a comprehensive picture of the ways in which government actions can affect real estate markets. Once the nature of the interventions is clear, the discussion turns to an economic analysis of their likely effects.

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S.V. Lall et al. (eds.), *Urban Land Markets*,
DOI 10.1007/978-1-4020-8862-9_1, © World Bank 2009

1.1.1 Urban Growth Boundaries

The first type of intervention, which is the easiest to visualize, is often referred to as an *urban growth boundary* (UGB). Under such a policy, the government effectively draws a ring around a city and outlaws urban development outside this ring. The urban growth boundary may be allowed to expand over time in response to population growth, but its presence nevertheless prevents conversion of rural land that would otherwise occur. One of the best-known examples of the use of UGBs is in the Republic of Korea, where greenbelt zones constrain the growth of cities. Korean greenbelts and their effects have been widely studied, with the World Bank involved in some of the research. Key contributions are by Hannah, Kim, and Mills (1993); Kim (1993); Son and Kim (1998); Green, Malpezzi, and Vandell (1994). These researchers conclude that Korean greenbelts are partly responsible, along with other elements of the country's housing policy, for Korea's relatively high housing prices. This conclusion is validated in the theoretical discussion in Sect. 1.2.

Land use is constrained by UGBs elsewhere in the world, including the United States. The American "smart growth" movement has made this kind of land use intervention more common, and the best-known example is the UGB surrounding Portland, Oregon. UGBs also exist in the United Kingdom, as explained by Cheshire and Sheppard (2002).

1.1.2 Floor Area Ratio Restrictions

A second land use intervention is the regulation of development densities. The goal of lower densities can be achieved in several ways. One approach is a minimum lot size restriction, which limits densities in areas with detached houses by requiring that each structure be surrounded by an ample land area. While minimum lot size rules are common in the United States, this kind of regulation does not apply in areas where apartment living is the norm, as in most built-up areas in lower-income countries.

An alternative approach to density regulation, which does apply in such cases, is the imposition of building height limits. These limits are imposed through a restriction on a structure's floor area ratio (FAR), which equals the total floor area in the building divided by the lot size. For example, a four-story building that covers half the lot area has an FAR of 2.0. A limit on the FAR prevents the developer from constructing a tall building.

Throughout the world, zoning regulations usually specify maximum FAR values in different parts of a city. But these FAR limits typically do not represent severe constraints on development, because they often roughly match the developer's preferred FAR value in a given location. In effect, FAR restrictions often "follow the market," providing a way for city planners to ensure that the character of development does not greatly diverge from the norm in a given area.

But in many cases FAR restrictions severely constrain the nature of land use. In Washington, D.C., and Paris, for example, building height limits are imposed

for aesthetic reasons, and they result in FAR values near both city centers that are far below those that a free market would produce. Lower-income countries also provide examples of stringent FAR regulations, with a case in point being India. Maximum FAR values in the central areas of Mumbai, Bangalore, and other major Indian cities are much lower than free market values. The dramatic effect of FAR regulation is easily seen in Mumbai, a peninsular city with severe land constraints and a vast population. Without FAR limits, land use in Mumbai would probably resemble the high-intensity pattern seen in Hong Kong (China), a similarly situated city. Instead, Mumbai is mostly a low-rise city, with the occasional tall buildings having been constructed under exemptions from the FAR regulations.

Arnott and MacKinnon (1977) provide a theoretical analysis of the effects of FAR restrictions, and Bertaud and Brueckner (2004, 2005) provide a more recent analysis along with a case study of Bangalore. The authors show theoretically that FAR limits, like UGBs, tend to raise housing prices in cities in which they are imposed, a conclusion that is further explained in Sect. 1.2. This prediction matches the reality in Mumbai, whose real estate prices are among the highest in the world.

1.1.3 Cost-Increasing Regulations

A third category includes a variety of land use interventions that may raise the cost of development. This class of interventions is well illustrated in the analysis of Malpezzi and Mayo (1997) and Bertaud and Malpezzi (2001), who study the case of Malaysia. They focus on regulations that require excessive road widths in newly developed areas (including provision of back alleys), excessive street setbacks for structures, and excessive requirements for community facilities in new developments. These authors also identify another, less tangible cost-increasing factor, which grows out of the process for securing government approval of new projects. Long regulatory delays in the approval process raise the cost of development, as does uncertainty about the outcome of the process (Mayo & Sheppard, 2001 provide a theoretical analysis of this second effect). While the impact of these cost-increasing interventions is clear in the discussion of the Malaysian case, an analogous impact can be expected in any real estate market in which such interventions are present. A key aspect of the impact is an increase in the price of housing, as the burden of the interventions is passed on to consumers.

1.1.4 Bureaucratic Control of Development Decisions

Rather than intervening through regulation of a private market, governments may control land use outcomes by taking the place of the developer, constructing and operating real estate projects themselves. This type of intervention may lead to land use outcomes very different from those a private market would produce. Such a divergence was strongly evident in some major cities of the former Soviet Union, which were the focus of considerable World Bank research. The most notable study, by Renaud and Bertaud (1997), shows that bureaucratic control of land use decisions led to a perverse, inverted population density pattern for the city of Moscow. The Soviet government constructed high-rise apartment buildings far from the city center while leaving land close to the center in low-intensity uses. This pattern, the opposite of the density pattern that would be produced by a free market, concentrated Moscow's population far from its employment center, leading to highly inefficient land use.

1.1.5 *Racially Based Land Use Interventions*

A final government intervention is specific to South Africa, where it was part of that country's apartheid policy. This intervention effectively controlled the residential locations of the black population, restricting black residents to living in townships on the fringes of the major cities and thus far from major employment centers. South Africa's township policy effectively produced a land use outcome like that in Moscow, where households living at high densities were forced to locate far from the city center. The high densities in this case arose not from a government decision to construct tall buildings on the fringe but from the poverty of the township residents, which dictated very low land consumption. South Africa's apartheid land use pattern, besides being offensive for the oppression it represented, also imposed huge costs on the population, a consequence of the massive time and money costs incurred as remote township residents undertook long commutes to jobs nearer the city centers. The effect of apartheid on land use in South African cities is analyzed by Brueckner (1996) from a theoretical perspective.

Since the kind of land use intervention practiced in South Africa was intimately tied to its unique racial policies, it is unlikely to be repeated elsewhere. However, Sect. 1.2 includes a general analysis of this case.

1.2 Economic Analysis of Land Use Interventions

This section presents a simple economic analysis of the impacts of the different types of land use interventions, using a diagrammatic approach. The analysis uses the standard urban model developed by Alonso (1964), Muth (1969), Mills (1967), and Wheaton (1974), which provides the best framework for analyzing land use interventions in a spatial context. The diagrammatic analysis illustrates the conclusions derived from a mathematical analysis using the standard model, whose details are not reported.

The basic elements of the model are easily explained. Each urban resident commutes to a job in the center of the city, incurring time and money costs that increase with the distance x from his or her dwelling to the city center. Residents consume housing as well as a catchall nonhousing good, and the price of housing varies

with location. This price, measured per square foot and denoted p, must fall as x increases to compensate remote households for their long and costly commutes.

Housing developers combine land and building materials to produce housing floor space, acquiring land at a rent of r per unit. Since p, the price of the housing output, falls as distance x from the center increases, land rent r must do the same to ensure that developers earn the same profit in all locations. Because land is then expensive near the center, while being cheaper farther out, developers economize on its use in constructing buildings near the center, using large amounts of building material per unit of land. Buildings are thus tall near the center, and their heights fall moving out toward the city's suburbs. The edge of the city, where land use switches from housing to agriculture, occurs at the point at which the urban land rent r falls to the level of the agricultural rent, denoted r_a. This urban boundary, denoted x^*, is shown in Fig. 1.1a.

1.2.1 *The Effect of an Urban Growth Boundary*

Figures 1.1a, b can be used to analyze the effect of an urban growth boundary. Suppose that a particular city, denoted city 1, is not subject to a UGB, with its border located at x^*. Then consider an otherwise identical city, denoted city 2, whose development is governed by a UGB, which fixes the city's border at $x_{ugb} < x^*$. The goal is to compare the characteristics of the two cities, and to do so, the following thought experiment is helpful. Suppose that a UGB is hypothetically imposed at distance x_{ugb} in city 1. This UGB would unrealistically require the city's area to shrink, with some land returned to rural use. Assuming that this hypothetical conversion occurs, further adjustments will then be required to restore a land use equilibrium in city 1, as explained in the following paragraph. But after the adjustment to the new equilibrium, city 1 should look just like city 2, which always had its UGB in place. Thus the differences between the original city 1 and the hypothetical post-UGB city can

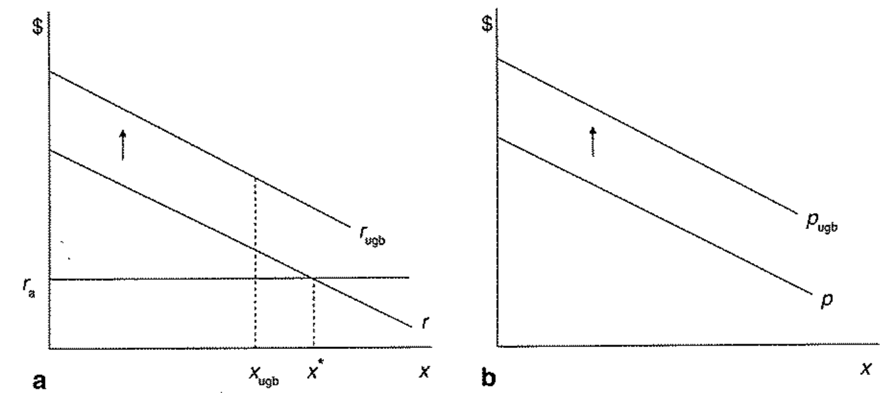

Fig. 1.1 Urban growth boundary (**a**) Effect on land rent, (**b**) Effect on housing price

be used to predict the differences between two existing cities (1 and 2), one with and one without a UGB.

In Fig. 1.1a the hypothetical imposition of the UGB in city 1 causes the land between x_{ugb} and x^* to be returned to rural use. While the original supply of housing in the city was adequate to house its population, this loss of developed land creates a situation in which the demand for housing exceeds the now smaller supply. In response to this excess demand, the price p per unit of housing rises throughout the city, causing the p curve in Fig. 1.1b to shift up to p_{ugb} (recall that, like r, p declines with x).[1] This housing price increase in turn raises the profits of housing developers, causing them to compete more vigorously for the city's land. Stiffer competition then bids up the land rent r at each location in the city, causing the land rent curve in Fig. 1.1a to shift up to r_{ugb}. In response to the higher land rent, developers build taller buildings. In addition, with the housing price higher, the city's residents choose smaller dwellings. With buildings taller and the dwellings within them smaller, population density rises throughout the city.

Recall that the post-UGB city can be used to predict the characteristics of city 2, which always had a UGB. Thus, compared with a city that has no UGB, a city that does have one is spatially smaller and has more expensive housing, higher land rents, taller buildings, and smaller dwellings. Since the incomes of the two cities are the same, the higher housing prices caused by the UGB lead to a lower standard of living, harming the city's residents. Unless there are offsetting benefits (as discussed further in Sect. 1.4), a UGB is a counterproductive land use intervention that makes consumers worse off.

1.2.2 The Effect of a Floor Area Ratio Restriction

The impact of an FAR limit can be analyzed using an analogous experiment. A new FAR limit is hypothetically imposed on a city without one, and the adjustments required to restore the land use equilibrium are analyzed. The features of the post-FAR-limit city can then be used to predict the characteristics of a city that always had an FAR limit in place.

Figure 1.2a shows the declining building height contour (denoted H) for the pre-FAR-limit city as well as the flat line corresponding to the limit. Since buildings taller than the limit, which are located near the center, must be (hypothetically) rebuilt at a shorter height when the limit is imposed, the FAR limit reduces housing supply in the area out to distance $x^\#$ in Fig. 1.2a. This supply loss creates excess demand for housing, which pushes up the housing price p throughout the city, just as in Fig. 1.1b. In response to this price increase, dwelling sizes shrink throughout the city.

Being unable to develop land to its highest and best use inside $x^\#$, where the FAR limit is binding, developers in this area offer less for the land than before, causing land

[1] For simplicity, the various curves in the figures are drawn as straight lines even though they are convex under the model. In addition, curve shifts are drawn as parallel even though they are nonparallel in general.

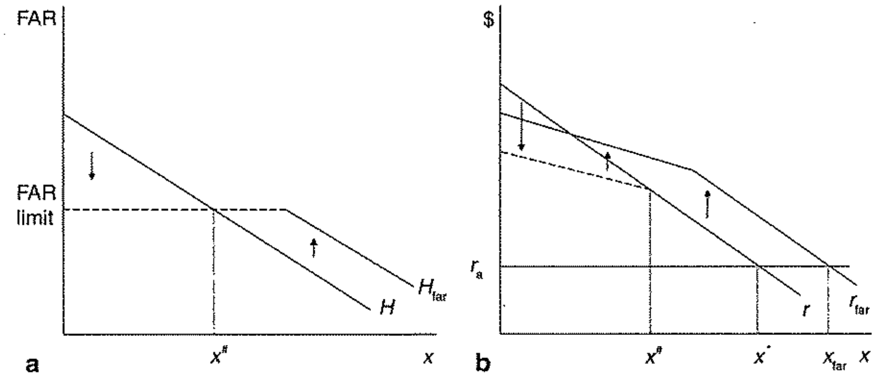

Fig. 1.2 Floor area ratio limit (**a**) Effect on building height, (**b**) Effect on land rent

rent r to fall. This effect is shown by the drop in the r curve inside $x^\#$ in Fig. 1.2b. But since higher housing prices raise developer profits, stiffer competition occurs for land throughout the city. As a result, land rent tends to rise at all locations, partly reversing the decline near the center. This effect is shown by the higher r_{far} curve in Fig. 1.2b. Even with this shift, however, land rent remains lower near the center.[2]

Higher land rent, in turn, raises desired building heights. But since developers remain constrained by the FAR limit, building heights can rise only in the outer part of the city, as seen in Fig. 1.2a (the H_{far} curve shows the new heights). In fact, with taller buildings desired throughout the city, the area where the FAR limit is binding expands beyond $x^\#$, as seen in the figure. Ironically, the attempt to constrain building heights causes buildings to grow taller in the outer part of the city, where the FAR limit is not binding. Finally, the upward shift in the land rent curve causes it to intersect agricultural rent r_a at a greater x value, denoted x_{far}, which pushes the edge of the city outward.

Thus by reducing housing supply in the city, the FAR limit leads to an increase in housing prices, which makes the residents worse off. In addition, the city expands spatially, and buildings grow taller wherever the FAR limit is not binding. As in the case of a UGB, imposing an FAR limit in the absence of offsetting benefits is a counterproductive policy that harms consumers.

1.2.3 The Effect of Cost-Increasing Regulations

Suppose that rather than a UGB or FAR limit, the government's land use intervention takes the form of a cost-increasing measure, such as greater regulatory delays

[2] Land rent could actually be higher near the center, thus rising everywhere, but the outcome in Fig. 1.2b appears to be typical.

or heightened regulatory uncertainty, which does not require the use of extra land inputs. Since a higher cost of development reduces the price the developer is willing to pay for the land, the land rent curve shifts down to r', as seen in Fig. 1.3. But with this shift, developers can no longer outbid farmers for the land between x^* and x', causing this land to be returned (hypothetically) to rural use. The resulting shrinkage in the housing supply then creates a situation of excess demand, which again leads to an increase in the housing price p throughout the city. Thus the p curve again shifts up, as in Fig. 1.1b, and dwelling sizes shrink in response.

The increase in p once again leads to higher land rents as developers compete more vigorously for the land, shifting the r curve upward in Fig. 1.3. The final land rent curve is given by the r_{cost} curve.

Building heights rise throughout the city in response to higher land rents, and this, combined with the drop in dwelling sizes, leads to higher population density in all locations. With higher densities, the city requires a smaller land area to fit its population. As a result, the new land rent curve must intersect agricultural rent at a smaller x value, denoted x_{cost}, which represents the city's border.

Thus a city facing higher development costs as a result of government interventions has higher housing prices, smaller dwellings, taller buildings, and a smaller spatial area than a city without such interventions.[3] Because of higher housing prices, city residents are once again worse off.

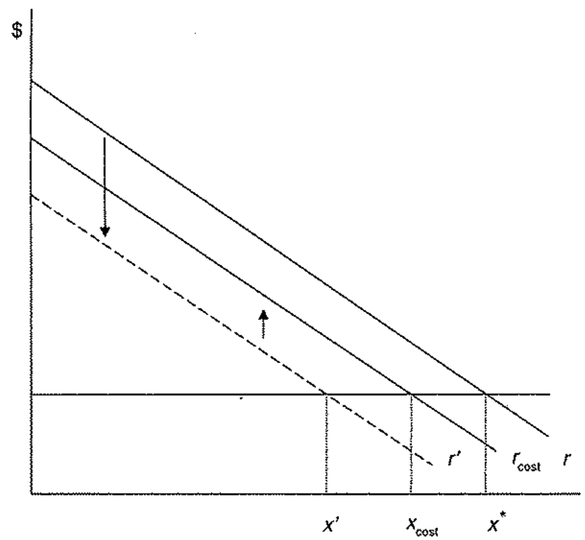

Fig. 1.3 Cost-increasing intervention

[3] Although land rent is shown as lower throughout the city in Fig. 1.3, the upward shift from r' to r_{cost} (which in actuality causes r to become steeper) could lead to an increase in rent near the center. When the cost-increasing regulations have the effect of increasing the amount of land used in housing production, this analysis must be modified. In this case, the city could grow spatially rather than shrinking.

1.2.4 *The Effect of a Minimum Floor Area Ratio*

Now suppose that the land use intervention consists of a policy that imposes a floor, rather than an upper limit, on FAR values in the city. Since a minimum FAR will be binding only far from the center, such a policy will lead to taller buildings in suburban locations. The effect of such a policy thus approximates the Soviet land use intervention in Moscow, where the government constructed high-rise apartment buildings far from the city center. The following analysis, however, does not exactly match the Soviet case because it assumes that private developers provide the city's housing, subject only to the minimum FAR requirement. Nevertheless, the analysis may provide some insight into the effect of the Soviet intervention.

Figure 1.4a shows the declining building height contour as well as the minimum FAR value. In response to the FAR floor, developers outside $x^\#$, where the floor is binding, are required to construct taller buildings (the new H curve is denoted $H_{min\text{-}far}$). As in the case of the FAR limit, this constraint on land use depresses the amount that developers are willing to offer for the land, causing a drop in r in the area outside $x^\#$, as shown in Fig. 1.4b. This decrease in land rent, in turn, means that developers are unable to outbid farmers for land outside the new r_a intersection point, denoted $x_{min\text{-}far}$, so that the land between $x_{min\text{-}far}$ and x^* is returned to agricultural use.

The resulting loss of developed land tends to cut the supply of housing in the city. But the remaining land outside $x^\#$ now has taller buildings, which tends to increase the city's housing supply. Mathematical analysis of the model shows that these effects exactly cancel each other, so that the supply of housing in the city remains unchanged as its border moves inward from x^* to $x_{min\text{-}far}$. With supply unchanged, the FAR floor has no effect on housing prices in the city and thus no effect on dwelling sizes. In addition, there is no further impact on land rent beyond that shown in Fig. 1.4b.

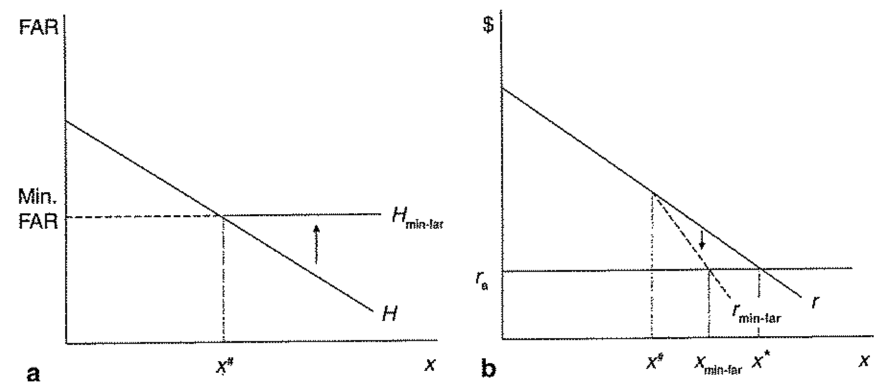

Fig. 1.4 Minimum floor area ratio **(a)** Effect on building height, **(b)** Effect on land rent

Without offsetting benefits, a distortionary land use intervention such as an FAR floor must make society worse off. But the absence of a housing price effect means that consumer welfare is unaffected by the FAR floor. Losers must exist, and they consist of a group that has received no mention so far: the owners of the land on which the city is built. In the standard urban model, these owners are assumed for simplicity to be absentee, living outside the city, an assumption maintained in the analysis above. Imposition of an FAR floor creates a loss for these absentee landowners because it lowers total land rent in the city. This outcome can be seen in Fig. 1.4b, since land rent falls in the outer part of the city, remaining unchanged elsewhere, while the city shrinks in area.

Absentee owners are also affected by the other government interventions analyzed. When a UGB is imposed, total urban land rent rises, benefiting the absentee landowners, as long as the UGB does not restrict the spatial size of the city too severely. When an FAR limit is imposed, total land rent is also likely to rise. In both cases, however, losses for consumers outweigh the gains of landowners, so that society as a whole is worse off. When a cost-increasing measure is put into place, total land rent is likely (but not guaranteed) to fall, an outcome that reinforces the loss to consumers.

1.2.5 The Effect of a Racially Based Land Use Intervention

As noted, apartheid in South Africa forced the black population to live in remote townships on the edges of cities. Analysis of this land use intervention requires an urban model with two household groups, black and white. The key economic difference between these groups is their income, with blacks poor and whites comparatively rich.

A standard urban model with two income groups usually predicts that the poor will live in the center and the rich in the suburbs, following the typical pattern in US cities. This outcome occurs because the low housing consumption of the poor gives them a comparative advantage in bidding for housing in locations where the price per square foot is high. Rich households, with much larger dwellings, are less able to tolerate high per-square-foot prices and are thus drawn to the suburbs, where a square foot of housing costs less.

Analytically, this difference is manifested in the land rent curves that relate to rich and poor (white and black) areas of the city. The black group's land rent curve is steeper, falling more rapidly as x increases, than that of the white group. This slope difference means that the black rent curve (denoted r_b) will be highest in the central part of the city, while the white curve (denoted r_w) will be highest in the suburbs, as shown in Fig. 1.5a. When the government exerts no control over where people can live, land will be occupied by the highest bidder, and the pattern in Fig. 1.5a will result in the poor black group living near the center and the white group living in the suburbs, as indicated in the figure.

Under apartheid, government intervention reversed this locational pattern, with black households forced to live far from the center and white households free to

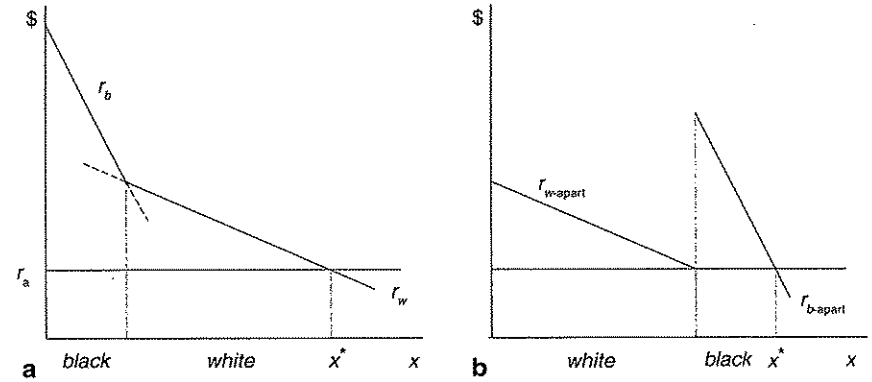

Fig. 1.5 Land use intervention under apartheid (**a**) Land rents in free market city, (**b**) Land rents in apartheid city

move into central neighborhoods. The resulting land rent pattern is seen in Fig. 1.5b. Forced to live far from the center, black households in the apartheid city no longer need to compete with whites for land near the center. As a result, they face much lower land rents and thus pay lower housing prices (their land rent curve is denoted $r_{b\text{-apart}}$ in Fig. 1.5b). But their commuting costs are now much higher, and mathematical analysis shows that this loss dominates the gain from cheaper housing, making blacks worse off.

Living close to the center, whites now benefit from lower commuting costs. Moreover, since whites do not need to compete with blacks for these central locations, they end up paying land rents (and thus housing prices) similar to those paid in the free market city (the white rent curve is denoted $r_{w\text{-apart}}$ in Fig. 1.5b). Even though the black rent curve is much higher than the white curve near the white-black border, the fact that blacks are barred from living near the center keeps them from outbidding whites for the city's central land. Because of this absence of competition in the land market, white households are better off in the apartheid city.

In addition to blacks, another group that loses with this policy is the absentee landowners, who earn a smaller total land rent than in the free market city, mainly as a result of the lower rents paid by blacks. This difference is easily seen in Fig. 1.5b.[4]

As in the Soviet case, the land use intervention under apartheid leads to an inefficient, inverted density pattern, with population densities in the outer part of the city much higher than in the white central neighborhoods. This pattern perversely concentrates the city's population far from its employment center. Unlike in Moscow, this outcome does not follow from the construction of excessively tall build-

[4] While Fig. 1.5 shows apartheid as having no effect on the overall spatial size of the city, this outcome would obtain only in special circumstances.

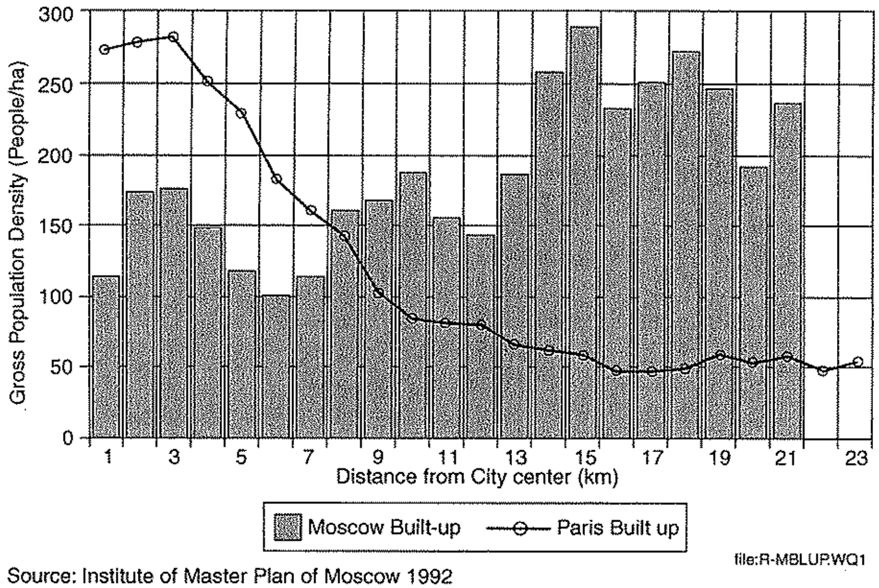

Fig. 1.6 Population density in Moscow and Paris (Source: Renaud & Bertaud, 1997, p. 141)

ings near the urban fringe but instead reflects the very small dwellings found in the black area of the city, which would be located close to the city center in an efficient land use pattern.

Data from Moscow and South Africa illustrate these two density patterns. Figure 1.6 shows the density pattern in Moscow along with that in Paris for purposes of comparison. Figure 1.7 shows the density pattern in Johannesburg (both figures are drawn from other sources; see notes). While the density patterns in the two figures are similar, recall that one results from an oppressive racial policy while the other follows from simple mistakes made by Soviet bureaucrats in charge of land use decisions.

Another analogy, perhaps more relevant to the South African case, can be found in China. Under the Chinese residential registration (*hukou*) system, migrants without official permission to relocate in a new city are denied many of the benefits available to legal residents, including access to formal housing (see Au & Henderson, 2006). As a result, many rural–urban migrants are forced to locate in informal settlements on the urban fringe, where housing is provided by rural cooperatives. While this housing is typically superior in quality to that in peripheral slums in other developing countries (such as the *favelas* in Brazil), it nevertheless has the high densities characteristic of the South African townships. The outcome is once again an inefficient concentration of population far from employment centers. Rather than resulting from a racial policy, this outcome in Chinese cities is a by-product of the government's attempt to control internal migration.

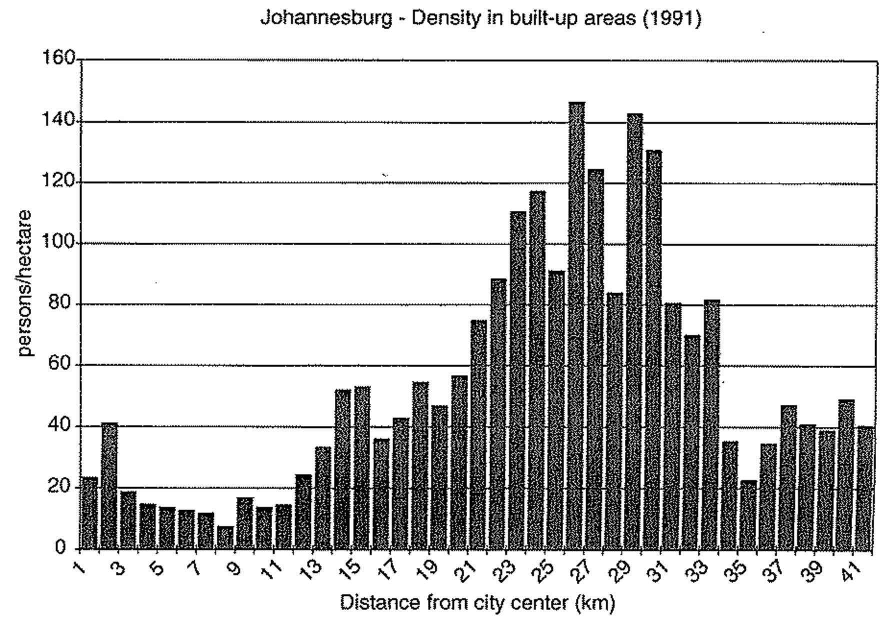

Fig. 1.7 Population density in Johannesburg (Source: Bertaud & Malpezzi, 2003, p. 74)

1.3 Quantitative Evidence on the Effect of Land Use Interventions

While the previous section presented a qualitative analysis of the effects of land use interventions, it is useful to gain a sense of the quantitative magnitudes of these effects. The following discussion provides some evidence on the relevant magnitudes, drawing both on empirical evidence and on the results of simulations of the mathematical model underlying the preceding analysis.

1.3.1 The Quantitative Effects of Urban Growth Boundaries and Floor Area Ratio Restrictions

Because cities constrained by urban growth boundaries differ from non-UGB cities in a host of other ways (including the presence of additional land use restrictions), it is difficult to use regression analysis to isolate the impact of a UGB on such variables as housing prices. Despite this limitation, researchers studying Korea present persuasive evidence that the country's greenbelts have contributed to its high housing prices. For example, data presented by Hannah et al. (1993) show that an index of Korean housing prices grew by a factor of 10 in 1974–1989, while real GDP rose by a factor of

3.4. While rising incomes, by increasing housing demand, surely played a role in this price escalation, the economy also faced severe land constraints. Urban residential land in Korea grew by only 65% in 1973–1988 even though the urban population rose by more than 100% over this period. With the greenbelt policy slowing the growth in the supply of residential land, and with population and income both rising rapidly, the conditions were ripe for a rapid escalation in Korean housing prices.

Numerical simulations of the urban model can also give a quantitative picture of the effects of a UGB. The simulation presented by Brueckner (2001) portrays a city of 2 million people that has a radius of 30.8 miles in the absence of government intervention. The government then imposes a draconian UGB that forces the city to contract to a radius of 15 miles. In response, the price per square foot of housing rises by about 15% in all locations, and population densities rise by about 75%. The UGB imposes a welfare cost per household of US $2,950, equal to about 7% of income (assumed to be US $40,000). Compared with estimates of welfare losses from other government interventions (e.g., taxes on capital and labor), this is a very large loss.

To empirically isolate the effect of an FAR limit on housing prices and other variables is also difficult. Numerical simulations, however, can once again provide some evidence. Bertaud and Brueckner (2004, 2005) analyze a city of 2 million people that has an FAR value of 17.5 at the city center, implying a building height of about 30 stories, in the absence of government intervention. A draconian FAR limit of 3.75 is then imposed, which restricts buildings to about 8 stories. In response, the price per square foot of housing rises by about 30% throughout the city, and the city's radius expands from 21.4 to 23.5 miles. In the new equilibrium, the FAR limit is binding out to a distance of 11.7 miles, beyond which FAR values drop below 3.75. Bertaud and Brueckner (2005) show theoretically that the consumer welfare loss from the FAR limit can be measured by the increase in commuting cost for a household living at the edge of the city. In the simulation this increase equals US $945 a year, or about 2% of household income (set at US $42,150).

Using these numerical results, Bertaud and Brueckner (2005) calculate the welfare loss generated by the very tight FAR restriction in Bangalore, which limits FAR values to about 1.5. This calculation requires an estimate of Bangalore's spatial expansion in response to the FAR limit, which can then be used to compute the extra commuting cost for an edge resident. Using the numerical simulation results as a guide in estimating the expansion, and drawing on Indian data on the cost of intracity travel, Bertaud and Brueckner (2005) estimate that the FAR limit generates an annual welfare loss per household of between 700 and 2,100 rupees, which represents between 1.5 and 4.5% of income. Once again, this welfare impact is large compared with impacts from other government interventions in the economy.

1.3.2 The Quantitative Effects of Other Land Use Interventions

Malpezzi and Mayo (1997), in their analysis of cost-increasing land use regulations in Malaysia, are able to generate a precise numerical estimate of the impact on cost

per dwelling. The authors focus on a representative dwelling with a delivery cost of about 28,000 Malaysian dollars. Malpezzi and Mayo attribute 4,000 Malaysian dollars of this amount to the effects of cost-increasing government regulations, a share of about 14%.

A number of papers take more systematic empirical approaches to measuring the effects of land use regulation, focusing mainly on US housing markets. One approach is to use land use regulation surveys, which ask local government officials to enumerate the regulations they employ, to generate a count of the regulations in place in various cities. This count index provides a measure of regulatory stringency, which can be used in a regression analysis to explain differentials in housing prices in a sample of cities.

This approach is followed by Ihlanfeldt (2007), Quigley and Raphael (2005), and Glaeser and Ward (2009). In Ihlanfeldt's paper, which uses a Florida sample, the list of regulatory measures includes farm preservation policies, development impact fees, large lot zoning, open space zoning, population caps, environmental preservation zoning, urban service boundaries, building permit limits, and a number of other policies. Ihlanfeldt's results show that when the count index for a city increases by one, indicating that the city is using an additional policy from the list, its single-family home prices increase by 8%. Using an analogous regulatory index in a sample of California cities, Quigley and Raphael (2005) find that adding one extra regulatory policy in a city raises the price of owner-occupied housing by 3–4.5% and rents by 1.5–2.3%. Glaeser and Ward (2009), using a Massachusetts sample, find that an additional regulatory policy in a city raises owner-occupied housing prices by 10%. Although these estimates differ somewhat in size, they provide a similar picture and confirm the effect of land use regulation on housing prices.

Several other studies are based on regulatory indexes that are computed in a less transparent fashion but again use detailed information on city-level policies. In a study of regulatory impacts in Maryland, Pollakowski and Wachter (1990) find that an increase in their index of zoning stringency raises owner-occupied housing prices. Their results also show that, because of spillover effects, housing prices rise when zoning stringency increases in nearby areas. Malpezzi, Chun, and Green (1998) study the impact of land use regulation in a national sample of US cities. The results show that when their regulatory index increases from a value at the top of the first quartile to the top of the third, owner-occupied housing prices rise by 32–46% and rents by 13–26%.

Another group of studies focuses on the effect of land use regulation on housing supply, again using various regulatory indexes. Mayer and Somerville (2000), using data from a panel of US cities, show that an increase in a count index of regulatory policies leads to a decline in housing permits. Quigley and Raphael (2005) find that an increase in their count index leads to smaller growth in the housing stock during 1990–2000 in their sample of California cities. Levine (1999), using the same California regulatory index, shows that an increase in the index reduces a city's 1990 housing stock for a given size of the stock in 1980. Finally, Green, Malpezzi, and Mayo (2005) estimate the elasticity of housing supply for each of 45 US metropolitan statistical areas and then regress this variable on a number of measures thought to be determinants of the supply elasticity. A regulatory index is one of these variables, and the regression results show that a higher index depresses the supply elasticity.

A final approach to analyzing the effect of land use regulations is indirect. Rather than relying on a measure of regulatory stringency, this approach focuses on the gap between house prices and construction costs. The approach attributes a large size for this gap to the supply-reducing effect of land use regulations (see Glaeser, Gyourko, & Saks, 2005).

1.4 Motivations for Land Use Interventions

Both the theoretical analysis of land use interventions in Sect. 1.2 and the empirical literature discussed in Sect. 1.3 focus on the effects of interventions while abstracting from the motives behind them. Since land use interventions may be motivated by an expectation of social benefits, a complete analysis must explore the sources of social benefits and whether the interventions actually produce the expected gains.

1.4.1 Motivations for Urban Growth Boundaries

Imposition of an urban growth boundary can be justified if urban expansion involves particular kinds of market failures. Suppose that the reduction in open space surrounding a city, a consequence of urban spatial expansion, generates a social loss for the city's residents, all of whom are assumed to be environmentally sensitive.[5] This loss must then be considered part of the cost of urban development, over and above the agricultural land rent that is forgone when development occurs. As a result, in determining the socially optimal spatial size for the city, urban land rent r must be set equal to the agricultural opportunity cost r_a plus an amount equal to the per-acre amenity value of open space. Since urban rent then exceeds r_a at the optimal urban boundary, the situation is like that shown in Fig. 1.1a, with the optimal boundary in a position like x_{ugb}, closer to the center than the free market boundary x^*. As a result, the optimal spatial size for the city can be generated by an appropriately chosen UGB, although a development tax set equal to the land's amenity value works equivalently.[6]

[5] For recent attempts to measure the benefits of open space, see Santerre and Bates (2001), Cheshire and Sheppard (2002), and Walsh (2007). Such studies usually attempt to measure the benefits of parks and other open space near residences, not the benefits from open space on the urban fringe. If consumers care only about the first type of open space, the environmental logic of UGBs (which are meant to make the urban fringe closer on average to households) is undermined.

[6] UGBs may also be motivated by infrastructure cost considerations. If housing developers are not charged for the full cost of the infrastructure required by their projects, development appears to be artificially cheap and the city overexpands (see Brueckner, 2001). While impact fees (which levy appropriate infrastructure charges) are the best remedy for this distortion, UGBs can also restrain a city's tendency toward excessive spatial growth.

This kind of environmental rationale appears to partly motivate the well-known UGB in Portland, Oregon, and it may help explain the UGBs in Korea and in the United Kingdom. If the motivation described above is accurate, a UGB produces social benefits from the preservation of open space that may offset the losses from the resulting increase in housing prices (recall Fig. 1.1b), leaving urban residents better off. However, if the supposed environmental gains are not perceived by consumers or are felt by only a small share of the population, the losses from the UGB will not be balanced by offsetting benefits, making urban residents as a whole worse off. This possibility reflects the potential danger of allowing urban land use policy to be set on the basis of principles (environmental or otherwise) that may not be widely shared in the population.[7]

A less benign view of the motivations for UGBs comes from the theoretical literature on urban growth controls, which is surveyed by Brueckner (1999). This literature portrays the owners of urban land as attempting to enrich themselves by restricting the amount of land available for development through a UGB. To understand this rent seeking motive, recall that total urban land rent (and thus the income of landowners) rises when a UGB is imposed, as long as the UGB does not restrict the spatial size of the city too severely. Although the model used above, which assumes that landowners live outside the city, does not provide a realistic setting for the rent seeking scenario, Brueckner and Lai (1996) provide a more accurate picture. In their model, the city contains homeowners who collectively own all the city's land (including the portion occupied by renters), and they attempt to increase the value of their property by limiting the land made available for development. This outcome is, of course, socially undesirable.

It is difficult to ascertain which view of the motivations for UGBs (environmental or rent seeking) describes the actual reasons behind their use. However, even when the benign environmental view is appropriate, the potential for misuse of UGBs in the service of a minority viewpoint certainly exists. Thus a concern is that, on average, the use of UGBs may not be socially beneficial.

1.4.2 Motivations for Floor Area Ratio Limits

As noted, the FAR limits that prevail in Washington, D.C. and Paris are aesthetically motivated. The Washington limit, which requires that no building in the District of Columbia be taller than the US Capitol, is meant to showcase the city's historical buildings and monuments, while the Paris limit is meant to preserve the city's unique character and ambience, possibly with an eye toward maintaining its tourist appeal. As explained, theory predicts that these FAR limits raise housing prices and

[7] In contrast to the environmental motivation for a UGB, which has a logical basis, a UGB rationale based on farmland preservation is illegitimate. The reason is that the agricultural rent r_a (which is forgone as a result of urban development) fully signals the scarcity of land in its food production role, which leads to socially correct decisions on conversion of the land in the absence of any market failures.

thus reduce the standard of living in the two cities. It is impossible to judge whether the associated aesthetic benefits justify these losses.

The draconian FAR limits imposed in Indian cities evidently are partly rooted in the subjective views of their city planners, who are reputed to dislike high urban densities. But a more practical concern related to urban infrastructure apparently plays a more significant role. The higher population densities that would emerge with looser FAR limits might require substantial upgrading of urban infrastructure—including roads, gas mains, and sewerage lines—at a high cost. Avoidance of these higher infrastructure costs evidently is a key reason that Indian planners impose tight FAR restrictions. While this kind of calculation may look sensible, it ignores the overall impact of an FAR limit on the urban equilibrium, which involves a greater spatial size for the city along with higher densities in the areas in which the limit is not binding (recall Fig. 1.2a). Since both effects impose additional infrastructure needs away from the city center, it is not clear that a city lowers its overall investment requirements by imposing an FAR limit.

Thus, as in the case of a UGB, the potential offsetting benefits of an FAR limit are uncertain, making it hard to argue that the costs of a limit are worth incurring. As a result, it seems likely that the severe FAR limits observed in some cities are not socially desirable.

1.4.3 Motivations for Other Policies

Among the other land use interventions considered, Moscow's inverted density pattern seems to be the simple result of poor land use decisions by Soviet bureaucrats, not the result of a conscious policy pursued to secure particular benefits. A benevolent motivation was obviously absent as well in South Africa's apartheid land use intervention, a reprehensible policy designed to serve the goals of a racist government.

By contrast, the cost-increasing land use interventions discussed are consciously designed to improve land use from the perspective of urban planners. For example, the street width requirement imposed in Malaysian housing developments obviously reflected the planners' view that wide streets increase the pleasantness of a residential area. Similar regulations, both in Malaysia and around the world, are motivated by analogous planning standards. The question, of course, is whether the gains in livability that result from such regulations are worth the higher costs, and thus the higher housing prices, that they generate. If the answer is yes, another question arises: if consumers do indeed value particular residential features more than the cost of providing them, why is any government intervention needed? Profit-maximizing developers would presumably provide such features on their own without any need for regulations directing them to do so. While the market can thus be trusted to provide residential features that are worth their cost, the danger is that well-meaning government interventions may lead to the opposite outcome, requiring developers to provide residential features that cost more than they are worth to consumers.

1.5 Land Use Interventions and Business Productivity

While the discussion so far has focused on the effects of land use interventions on consumers, the effects on firms may also be important. One type of impact, which operates through the cost of real estate inputs, emerges from extending the analysis of Sect. 1.2. That analysis shows that various land use interventions can be expected to raise the price per square foot of housing for consumers. Although the model does not consider business land use, assuming for simplicity that all jobs are concentrated at a point in space (the city center), a more realistic model would depict a city with both business and residential areas. In such a model land use interventions such as a UGB or FAR limit would raise the cost of real estate for both consumers and businesses, putting upward pressure on the price per square foot for both types of floor space. The resulting cost increase for businesses could generate a number of secondary effects, such as an escalation of firms' output prices along with a potential decline in wages.

A new line of research suggests another avenue by which land use interventions might affect business operations. This research, part of the literature on the new economic geography, identifies a connection between the density of employment in a city and the productivity of its workers. This connection arises through agglomeration economies, under which high densities foster interfirm interactions, which may raise productivity through a number of channels. These channels include more vigorous exchanges of knowledge between firms in dense environments as well as better matching of workers and jobs in areas with specialized, dense labor markets. Two studies using US data provide evidence for such an effect. Ciccone and Hall (1996) show that output per worker rises with employment density, while Carlino, Chatterjee, and Hunt (2007) show that patents per capita in a city (a measure of intellectual output) rise as the density of employment increases.

These findings suggest that government land use interventions designed to reduce densities may have a negative effect on firm productivity. For example, draconian FAR limits like those in India, by reducing both residential and employment densities, may make Indian firms less productive. Thus, the higher real estate costs due to density restrictions may be accompanied by a more fundamental negative impact on worker productivity. This conclusion reinforces the message of Sect. 1.4: since the unanticipated negative effects of government land use interventions may extend beyond consumers, affecting firms as well, a moderate approach that avoids draconian interventions is preferable.

1.6 Conclusions

The analysis in this chapter points to a potential pitfall in government land use interventions. Well-meaning interventions that cause land use outcomes to diverge substantially from free market outcomes run the risk of generating net social losses. The problem is that the expected benefits from large interventions may be swamped by unanticipated losses, which may be overlooked by government officials who act with an incomplete understanding of the operation of real estate markets.

Despite this view, government interventions that are designed to foster orderly urban development are useful. Western-style zoning laws, whose main purpose is to segregate different land uses with the goal of limiting negative externalities, are beneficial. However, to avoid creating artificial scarcities, such zoning laws must respond to market forces in determining the overall allocation of land to residential, commercial, and industrial uses. In addition, the density regulations (including FAR limits) that are usually part of zoning ordinances can foster orderly land use by ensuring uniformity of development in an area. Ideally, however, such regulations should approximately match the area's free market densities, serving more as a guide to development than as a binding constraint. Similarly, urban growth boundaries can play a beneficial role to the extent that they discourage scattered, noncontiguous development rather than serving as binding limits on the total amount of land available for conversion to urban use. Generally, government land use interventions that are designed to guide development rather than fundamentally diverting it from a free market path are likely to be socially beneficial. Draconian interventions, however, may lead to a decline in social welfare.

Acknowledgments The author thanks Vernon Henderson, Gregory Ingram, and the other participants in the preconference workshop for helpful comments.

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