



An Analysis of Urban Growth Controls through Game Theory and the Contingent Valuation Method

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A mis padres

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Chapter 1

Introduction

The goals of this research consist in contributing to the understanding of the economic factors that are behind the extended use of regulations in the land market and to discuss their economic impacts, in the context of the urban growth process.

The land market presents specific features which makes its study especially interesting from an economic point of view. One of its key characteristics is that the good is immobile, what implies that land needs to be treated as a differentiated good. This heterogeneity that results from location is captured in many theoretical models by the space dimension, namely by distance to a particular reference point. Also associated to the immobility feature is the fact that externalities might arise from economic activities that take place at relatively close locations. This existence of external effects has been a key point in justifying the use of regulating instruments. Land-use regulations are present in one way or another in virtually all planning systems, what makes the land market especially interesting since it provides many opportunities to study the effects that the public intervention causes (Evans, 1999). Land is a key input in most economic activities, too. This provokes that the functioning of the market and land prices may have a great impact in the economy, and in other goods such as housing. For all these reasons, the questions of how planning measures arise, and what their efficiency consequences are, have received a great deal of attention, both at the theoretical and

at the empirical level. This dissertation focuses on how game theory may help in the understanding of the emergence of planning restrictions, it compares the performance of alternative planning instruments, and it proposes an empirical approach to investigate on the impacts of such instruments on the urban environment and the welfare of residents.

Land-use controls have been typically justified on economic grounds as the remedy to achieve the optimum in a market in which externalities are present and in which not all the competitive conditions are met. According to Brueckner (2001), “the spatial growth of cities is due to the expansion of population, rising incomes, and falling commuting costs”. In this process of urban growth, however, three main market failures are present. These include: failure to account for the benefits of open space; excessive commuting because of a failure to account for the social costs of congestion; and failure to make new development pay for the infrastructure costs it generates. Of course, the recognition that market failures exist does not automatically imply that any public intervention used, even when aimed at improving the market outcome, will bring about more efficient results (Glaeser, 1998). As it will be mentioned below, from the urban economics literature devoted to the analysis of planning regulations it emerges a rather pessimistic view regarding the goodness of the urban growth restrictions used (Fischel, 1990a). Planning practice shows that this suspicion towards land-use controls hardly has any effect on local planners decisions. On the contrary, the urban sprawl and urban sustainability debates have encouraged the use of urban growth restrictions at the local level. Thus, local and regional politicians have started recurring to an increase in the stringency of the controls to try to slow down urban growth. Urban growth, and more specifically urban sprawl, is allegedly at the root of a variety of environmental problems urban residents care about.

Since the late eighties, empirical studies analyzing the relationship between urban form and certain environmental variables such as fuel or energy consumption have pro-

liferated¹. Although there is no conclusive evidence that proves the relative efficiency of high density urban development, the truth is that local planners have recovered an important new role to land-use controls: the preservation of the urban environment. Thus, practitioners regard planning restrictions as the necessary means to prevent urban sprawl. This issue and related aspects of the relationship between urban growth controls and the environment have gained attention in the theoretical urban literature as well.

There is a wide range of studies that deal with the economic consequences of land-use planning. At the theoretical level, models usually adopt the bid-rent framework, and then incorporate some type of restriction on the land market, usually in the form of zoning regulations. Such studies focus on the impact that controlling policies have on welfare and, as a result, on the consequences on efficiency terms. Other economic aspects are also studied: how supply and demand decisions on the land market are affected, what the impacts on land and housing prices are, the extent to which externalities are corrected, or the development of the political process that ultimately leads to the adoption of planning restrictions. A survey of the literature is offered in Pogodzinski and Sass (1990).

Several articles on urban growth controls have been built as extensions to the basic context based on the bid-rent approach [Sakashita (1995); (Ding, Knaap and Hopkins, 1999); (Brueckner and Lai, 1996);(Sasaki, 1998)]. A few years ago a new line of research appeared in articles by Helsley and Strange (1995) and Brueckner (1998). It basically consisted in analyzing land-use restrictions as the result of some type of strategic interaction among local jurisdictions, and more than focusing on the consequences of the chosen controls, they put the emphasis on the rationale behind the specific choices that cities make.

¹For a review of works on urban form and travel, see Crane (1999)

Studies centered on the effects of land-use restrictions usually lack generality, and the results are very much sensitive to the specific assumptions adopted. Outcomes may vary for example with the degree of closure of cities, with the pattern of landownership, or the number of cities imposing the restrictions (Pasha, 1992). This fact provokes that there is a wide range of studies that, though dealing with the same issue, achieve contradictory conclusions. See for instance Engle, Navarro and Carson (1992) and Brueckner (1990) for open-city frameworks, and Brueckner (1996) for a closed-city approach. These contradictory results contribute to the lack of general consensus on the convenience or effectiveness of land-use regulations. Yet, from the reading of the literature one gets the impression that urban economists do not generally rely on land-use controls as instruments to correct market failures, in particular, on urban growth regulations as they are set in practice (Anas, Arnott and Small, 1998). Most often, urban growth controls are said to diminish welfare, and even when they are assigned a positive role in order to achieve congestion and pollution reductions, they are believed to be inferior compared to alternative instruments such as taxes or impact fees (Brueckner, 1997).

In a paper that a decade ago attempted to provide guidance for academics contemplating research on land-use controls, Fischel (1990b) pointed out what he believed would be the main elements that should be considered in research. These elements could be summarized in the following:

- Land-use regulations must be viewed as a flexible and decentralized network of local restrictions, not as a single-valued constraint
- Restrictions in the land market confer benefits and costs that are capitalized as increases or decreases of property values. Aggregate community land values are the key to measure the efficiency of the regulation
- Land-use controls are the product of economically rational political activity

While it is not rare that the last two are considered in the literature, to our knowledge the first one has been neglected. The last two suggestions and to an extent the first one have been taken into account in the theoretical part of this dissertation.

Assuming that land-use controls result from economically rational political activity equals to considering that rather than analyzing the effects of exogenous land-use controls, only endogenous land-use controls should be considered, in the sense that they are the result of maximizing some objective function. In particular, Fischel suggested that the appropriate objective function to be used is total land rents, because they capture the benefits and costs derived from the controls. Other authors have put this suggestion into practice –see for instance Brueckner (1995). These two recommendations have been followed in the theoretical works developed in this dissertation, because only endogenous controls, most of the times arising from the maximization of total land rents in the city, have been considered. Finally, the first point somehow reflects the fact that in real practice several land-use controls are simultaneously used, while the theoretical literature usually focuses on the analysis of a single type of regulation. In practice, there may be redundancy or contradictions in the use of the controls.

Three research studies have been carried out, the three of them dealing with different aspects of land-use regulation. Two of the chapters analyze urban growth controls from a theoretical perspective, built upon the framework of the bid-rent model. The third one provides an alternative empirical approach to investigate into the convenience of moving towards more or less dense urban growth in a particular area, the Metropolitan Region of Barcelona, when accounting for the associated environmental effects that may justify urban growth controls.

The dissertation organizes as follows. First, in chapter 2, two types of growth controls are analyzed. It is used a context of a closed system of interdependent cities where utility is determined endogenously. The focus is on how the use of population

growth controls and, alternatively, the use of taxes on housing consumption, affect utility levels, taxes revenues and the city size, in a simple context in which households' utility is not affected by environmental amenities. Thus, the analysis belongs to the family of the so-called *supply-restriction* models. These focus on the effects that regulations cause on land supply. The point is that since effective regulations restrict available land, then land prices are artificially pushed up. Several scenarios are analyzed, with particular attention to the emerging equilibria when strategic interaction between cities takes place, both considering static and dynamic horizons, and allowing for the possibility that non-cooperative equilibrium solutions arise. The consideration of dynamic games and the possibility of cooperative solutions had not been done before. It is shown that cooperation between jurisdictions and the subsequent choice of stringer population controls and higher taxes constitute the equilibrium solution when interaction is to occur for an indefinite period of time. For a given tax revenue, taxes prove superior to population controls as long as the comparison is between tax revenue and increased land rents.

In chapter 3 the analysis is again focused on the determination of urban growth controls, in a setting where it is density levels that are simultaneously chosen by cities. This is a widely applied land-use control in real practice, but it has been hardly considered in the theoretical literature dealing with the effects of urban growth controls. Since density negatively contributes to the utility of residents, an *amenity-creation*-type model is now considered. The underlying reasoning in amenity-creation models is that planning restrictions would overcome some external costs associated to the growth of cities, the urban environmental conditions would improve, and this improvement would logically capitalize into higher prices. The model borrows some of the assumptions of the previous one. It will be considered again a closed-city framework, land-use controls respond to the maximization of land rents in the cities, and interaction among local jurisdictions is likewise considered. Also, some distinct features apply. The effects of

urban growth controls are accounted for in a different manner. Firstly, by incorporating the potential benefits of using regulations (namely restricting densities), and secondly by allowing for some market response to the regulations. It results that when city boundaries are easily adjustable and cities compete with densities, the density levels arising from the competition process are too low compared to optimal levels.

In chapter 4 an empirical exercise based on the Contingent Valuation method is developed. Although the methodology is well-known and it has been widely applied for the valuation of environmental goods, its application to the environmental consequences of planning restrictions is novel. The study provides an alternative empirical approach to identify optimal urban growth when accounting for its associated environmental effects. Rather than focusing on the energy and pollution consequences of urban form often discussed in the literature, this paper analyzes the problem of the so-called sustainable city from the perspective of the environmental amenities as perceived by residents. Departing from the existing trade-off between the environmental benefits derived from living at lower densities and the environmental costs of transforming rural landscapes to urban uses, the exercise analyzes whether more compact or more disperse urban growth would be socially desirable in a particular area, the Metropolitan Region of Barcelona. The results are obtained from a market simulation exercise that uses contingent valuation data. It yielded a positive willingness to pay estimator for a diminishment of density levels within cities in the area, even if this implies losing a part of their surrounding landscapes. Accordingly, a more compact city scenario would be welfare-decreasing in aggregate terms. The results suggest that, in the area of study, actual urban growth controls leading to rather high densities would not be justified on environmental grounds, since they would be over-correcting the potential externalities arising from the loss of undeveloped landscapes. Likewise, we argue that although proposals on compacting cities could indeed constitute a desirable planning goal in some instances, more general claims are not necessarily in the interest

of residents.

A chapter of conclusions that summarizes the main results and the lines of further research follows in chapter 5. The dissertation finally includes a Bibliography chapter and two appendix chapters, collecting the main algebra and calculations regarding the first theoretical chapter, and the descriptive statistics and estimation results from the contingent valuation study.