HOUSING, SPRAWL, AND THE USE OF DEVELOPMENT IMPACT FEES: THE CASE OF THE INLAND EMPIRE

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This article is concerned with the economics of excessively large and socially costly suburban expansion and attempts to summarize and organize the main economic arguments associated with sprawl due to single-family residential home construction. We also apply standard welfare economics and price policy instruments to the issue of suburban sprawl in order to suggest ways in which economics can participate in and inform the debate over sprawl. The article uses the Inland Empire, which includes the valley regions of San Bernardino and Riverside Counties in Southern California east of Los Angeles, as a case study. (*JEL* R11, R14, Q24)

I. INTRODUCTION

This article is concerned with the economics of excessively large and socially costly suburban expansion and attempts to summarize and organize the main economic arguments associated with sprawl due to single-family residential home construction. The topic is of interest not only because the social costs of sprawl may be high but also because what seem like fairly clear economic issues have been at least partially obscured by the debate over sprawl. This has led to obfuscation to the point that well-accepted economic notions have not been able to fulfill their clarifying potential and standard economic instruments to internalize externalities remain on the sidelines.

This article presents some of these confusions and debates for review. We also apply standard welfare economics and price instruments to the issue of suburban sprawl in order to suggest ways in which economics can participate in and inform the debate. The article uses the Inland Empire, which includes the valley regions of San Bernardino and Riverside Counties in Southern California east of Los Angeles, as a case study.

The Inland Empire is very large, with a population of about 3.8 million. Indeed, though dwarfed by Los Angeles County if the region were a state, it would be larger than exactly half the U.S. states (California Department of Finance Web site; Husing, 2005). The region is a good one for the purpose because key policy issues related to property rights, housing affordability, and externalities closely associated with housing choices that are of nationwide interest are being debated particularly actively in the region. Part of the reason sprawl and its effects are so much in the forefront in the Inland Empire is that the region has experienced an enormous building boom during the past 10 yr. In 2004, there were

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ABBREVIATIONS

APA: American Planning Association
CARB: California Air Resources Board
MB: Marginal Benefits
MC: Marginal Costs
MSC: Marginal Social Cost
PEMS: Performance Measurement System
PM: Particulate Matter
SCAG: Southern California Association of Governments
SCAQMD: South Coast Air Quality Management District
SMSA: Standard Metropolitan Statistical Area

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36,000 single-family housing building permits issued in the two-county region, which represented 25% of the total new permits in the State of California and placed the Inland Empire third in the nation (behind Atlanta and Phoenix) in terms of number of building permits issued by a standard metropolitan statistical area (SMSA) (Berkman, 2004; Wilson and Kelley, 2003). In the first 9 mo of 2005, a whopping 52% of all new homes constructed in California were built in the Inland Empire (Husing, 2005).

The next section presents various definitions of sprawl that have been used in the literature. Section 3 lays out a standard economic definition of sprawl and discusses critical measurement issues. Section 4 delves more deeply into the three main negative externalities associated with sprawl—road congestion/air pollution, loss of open space, and demands on public infrastructure—using the Inland Empire as a case study. The argument has been made that these externalities should be given lower weight than housing construction because there exists a housing shortage in California. Section 5 therefore examines this notion from a theoretical and empirical perspective and concludes that such claims should be viewed with caution. Section 6 moves the article into the policy arena through an examination of price instruments such as fees, which are often used for controlling pollution externalities and in some cases also sprawl. The section also presents some key barriers to using these instruments in the United States. The final section concludes the article.

II. DEFINING SPRAWL

For many reasons, sprawl has proven to be a difficult issue to define, much less examine from an economic perspective as we attempt to do in the following section. Wassmer (2000) and Burchell, Downs, and Mukherji (2005) note that the term "sprawl" has been used by urban planners, environmentalists, and others with contempt and disapproval, but also note that sprawl is not synonymous with metropolitan growth. Instead, it is a dysfunctional style of growth. Hess (2001) simply notes that "sprawl has become the term people use to describe anything they do not like about American cities."

Going beyond general notions has been difficult at least since 1965 (Harvey and Clark, 1965). More currently, Burchell, Downs, and Mukherji (2005) and Galster et al. (2001) find that there is still no common definition of sprawl. In addition, both these articles conclude that there are limited means to determine levels of sprawl or compare sprawl across different areas. Downs (1998) and others therefore describe sprawl by observable traits, such as low densities, strip commercial, and leapfrog development patterns. Ewing (1997) defines sprawl as "noncompact development." Ewing, Pendall, Chen (2001) note that "people living in more sprawling regions tend to drive greater distances, own more cars, breathe more polluted air, face greater risks of traffic fatalities and walk and use transit less." Burchell, Downs, and Mukherji (2005) define sprawl as "low density, rapidly spreading urban development that leapfrogs out from an urban center."

Galster et al. (2001) provide an interesting review of definitions of sprawl that have been used in the literature and group them into several categories. First, sprawl can be defined by its characteristics (e.g., scattered or low-density development). Sprawl can also be an aesthetic judgment (e.g., ugliness), an uninternalized externality (e.g., traffic congestion), or defined in terms of linkages to something else. Downs (1998) and Black (1996), for example, suggest that sprawl is indicated by fragmented local or regional planning, but it is also frequently described as conforming to specific patterns of development (e.g., ribbon development, leapfrog development). Finally, Ewing (1997) and Harvey and Clark (1965) see sprawl as organically linked with development, suggesting perhaps that areas may pass through sprawl stages in the process of becoming more compact. The problem, of course, is that in the process, irreversible losses of public goods such as open space, habitat, and biodiversity may occur.

It is hard to find consensus on a definition of sprawl because precisely defining and measuring the negative externalities participants in housing markets impose on existing residents and each other is difficult. Brueckner (2001) and Wassmer (2000) break the costs into four categories. Perhaps, the most often noted are losses of farmland and open space amenities. Urban expansion may also lead to longer commutes, generating excessive congestion, and air pollution. Third, growth at the fringe pulls development away from the city center and

can lead to deterioration of city centers. Finally, some claim that low-density suburban development reduces the social bonds that hold societies together.

Song and Knaap (2004) particularly highlight the effects of homogeneous land uses, low density, and poor connectivity. They point to the winding streets, cul-de-sacs, and large blocks that are typical of suburban areas and argue that low-density development with poor connectivity increases dependency on automobiles, consumes farmland and open space, and raises the cost of public infrastructure. The American Planning Association (APA) suggests that less mixing of land uses leads to less walking and bike riding, more vehicle miles traveled, worse air quality, and reduced aesthetic beauty.

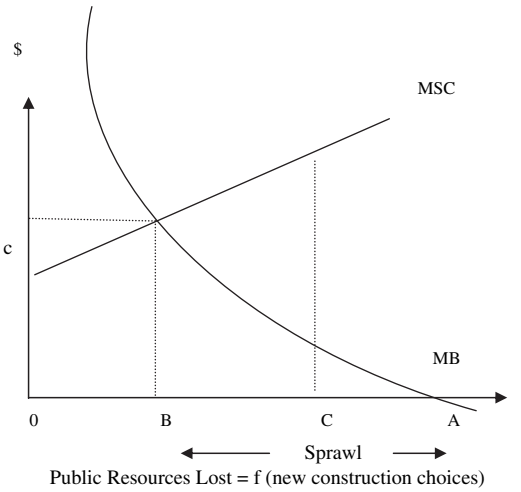
Brueckner (2001) identifies three key market failures associated with sprawl that lead to excessive spatial growth, generating social costs. The first is the failure to account for the social value of open space near metropolitan areas. Second, individuals fail to take into account the full social costs of commuting when they choose to locate their homes away from work and other destinations. Third, real estate developers may not pay the full costs of infrastructure needed to service new development, leading to an overestimation of net benefits. He and other authors note that spread out development close to the fringe of urban areas increases infrastructure costs per household compared with closer in, higher density neighborhoods (Burchell et al., 2002; Harvey and Clark, 1965). Sprawl therefore causes urban land to be used inefficiently because land that is closer to the center of a metropolitan area where infrastructure already exists is passed up for cheaper land further from the city center. This increases burden on local governments (Heim, 2001).

All three of these failures distort the forces that drive the spatial expansion of cities. Correcting these failures would alter the spatial pattern and potentially also the level of development, increasing social welfare. As Brueckner (2001) points out, however, the key challenge is to choose the right instruments for internalizing these externalities.

III. THE SIMPLE ECONOMICS OF SPRAWL

Although the term sprawl can be used in a variety of ways, from an economic perspective, the meaning is fairly clear. It is obvious, for example, that sprawl exists when public resources[1] are converted to private goods (e.g., houses, yards, and shopping centers) such that overall social welfare is reduced. This would be a very conservative notion, however, because in a Pareto economic sense, the bar for defining optimal sets of outcomes would be set much higher. For example, with the usual caveats, basic microeconomic theory supports the development of competitive markets not because we lose nothing but because they are believed to add the *maximum* to social welfare. With market failures, such as excessive loss of public resources, the goal should remain to maximize social welfare rather than assure it is nondecreasing. This focus on the optimum is consistent with Brueckner (2001) and Wassmer (2000) who define urban sprawl as spatial growth, that is, "excessive" relative to what is socially desired.[2]

FIGURE 1
A Graphical Depiction of Sprawl



This situation is presented in Figure 1. On the horizontal axis is an index of public resources reduced, which is some positive function of new housing construction choices. On the vertical axis are the benefits received by

1. Because not all the goods lost due to sprawl are pure public goods, we use the more general term "public resources," which may include pure and partial public goods. We thank a reviewer for this suggestion. In general, goods lost due to sprawl have significant public good aspects.

2. Adding weights to cost-benefit analyses that overemphasize the welfare of some members of society over others could potentially alter simple Pareto-based conclusions.

developers and migrants from reducing those public resources. These might be profits to developers and enjoyment of living on larger lots outside city centers for buyers, both of which are captured by market prices. Also on the vertical axis are the external costs associated with lost public resources. These might be lost enjoyment of open space, health effects from air pollution, time lost due to congestion, reduced utility from knowing natural landscapes have been altered, orange groves bulldozed, and species lost. Simply for convenience, these are measured in dollars.

The functions depicted are the marginal benefits (MBs) and costs (MCs) of allowing public resources to be degraded. The costs are the marginal losses of utility to those who enjoy those goods and the benefits are the marginal net benefits of housing (i.e., the private good) made possible by degrading public resources. Marginal social cost slopes upward, reflecting increasing marginal damages (e.g., conversion of increasingly sensitive lands for housing and higher marginal health costs due to air pollution), and MB declines indicating that early migrants are likely to get higher net benefits (e.g., access to good views, lower land prices) than those who come later. This is a standard analytical framework in economics that can be readily applied to the question of sprawl.

Without any policy, welfare maximizing buyers and sellers of houses degrade public resources until there are no more net benefits from degrading them or where MB = 0; without public subsidies, further degradation should not be observed. Is this optimal? The answer is typically no because when MB = 0, the extra social cost of development exceeds the benefit.[3] Indeed, anything past the intersection of the two curves (Point B) has this feature.

Development should occur in a Pareto economic sense in a fashion and magnitude such that the MB of degradation equals the MC because this level maximizes social welfare. This point brings us to a rigorous notion of sprawl because any set of development choices that cause degradation of public resources beyond Point B is excessive. Sprawling development can therefore be defined as any pattern of development that causes degradation of public resources greater than B.[4] Suppose Point C represents the level and pattern of development such that the total benefits of development (i.e., consumer plus producer surplus) equal the total costs (i.e., the loss of public resources). Often, in conventional parlance, development to the right of Point C defines sprawl, but we would like to note this view is at odds with standard welfare economics. Indeed, Point C corresponds to an open access equilibrium occurring when only private benefits and costs are considered.

Key challenges in analyzing sprawl are to meaningfully identify the public costs of various patterns of new construction and measure excessive when (a) preferences are heterogeneous (i.e., not everyone cares about open space, clean air, or the loss of the endangered kangaroo rat) and (b) the costs of development are often in terms of lost public goods, which are typically difficult to identify precisely, quantify, and incorporate into public policies. For example, if one aspect of sprawl is architectural homogeneity that bothers some but not others, measuring these costs, much less incorporating them into public policies, becomes a very contentious issue.

A number of researchers have attempted to measure sprawl, but to date, only simple metrics have been used. Wassmer (2000) looks at the percentage change in the population that lived and worked in city centers between 1950 and the mid-1990s and notes that the percentage of people in city centers fell from 57%–35% and those working in the city centers declined from 70% to 45%. Based on these definitions, he concludes that sprawl increased over time. This approach is also roughly that of Brueckner (2001) who notes that in many cities, growth of urban areas outpaced population growth. For example, the Chicago metropolitan area increased by 46% between 1970 and 1990 while the population only grew 4%. In an even more dramatic example, the size of the Cleveland metropolitan area grew 33% while the population declined by 8%.

Galster et al. (2001) suggest eight quantifiable dimensions of sprawl: density, continuity, concentration, clustering, centrality, nuclearity, mixed uses, and proximity. The exact definition of each of these dimensions is not

3. Unless by chance, MC is everywhere below MB or if at Point A, MB = MC = 0.

4. This conclusion presumes that markets maximize the MB per lost public resource (rather unlikely) and policies minimize the marginal social costs of lost public resources (rather more likely).

needed for this article. What is of interest is their focus on patterns of land development to identify sprawl rather than the outcomes of development. Using these eight measures, Galster et al. (2001) find that Atlanta, Detroit, Miami, and Denver ranked high on the sprawl index and New York, Philadelphia, Boston, and Chicago ranked low. The Los Angeles SMSA ranked low on the sprawl index for many measures.

Song and Knaap (2004) suggest that quantifying urban sprawl by focusing on growth of suburbs relative to central cities provides information about population growth but says little about the form of growth. They assert that studies such as Fulton et al. (2001) and Sierra Club (1998) that rely on density may therefore add little to the sprawl debate.

Since there is a variety of generally simple ways to measure sprawl, studies frequently produce conflicting results and depending on the measures used, the Inland Empire ranges from the worst in the country to not so bad. Ewing, Pendall, Chen (2001) ranked the Inland Empire very badly using 22 different measures of residential proximity to city centers, degree of mixed uses in neighborhoods, strength of activity centers and downtown, residential density, and connectivity of street networks. They find that the region has few areas that serve as focal points for communities and that more than 66% of the population lives over 10 miles from a business district. In addition, the area has little mix of land uses and residential density is below average, with less than 1% of Riverside County's population living in communities with enough density to be effectively served by transit. They therefore conclude that the Inland Empire is the most sprawling region in the country.

A nationwide study by Rutgers and Cornell University researchers agreed and concluded that the Inland Empire by a wide margin tops the nation with regard to sprawl. The region is worse than 82 other metropolitan areas in terms of road function and safety, proximity of homes to business districts, jobs and services, and identifiability of downtown activity centers (Gold and Ritsch, 2002). In 2001, however, USA Today published results of a study (http://www.usatoday.com/news/sprawl/main.htm) measuring sprawl in 271 cities in the country. The results were based on the percentage of the population that lived outside urban areas and the change in that proportion over time. Using this approach, the Los Angeles—Riverside—Orange County region was rated as one of the least sprawling areas in the country, exhibiting far less sprawl than Portland, Oregon, and Boston, Massachusetts.

IV. THE THREE KEY COSTS OF SPRAWL: A VIEW FROM THE INLAND EMPIRE

This section focuses on the costs of sprawl in terms of the three market failures discussed earlier: the failure to account for road congestion/air pollution, the opportunity cost of lost open space, and public infrastructure used by those who buy new homes. One of the most cited costs of sprawl in the Inland Empire is excessive freeway congestion leading to air pollution and time losses for drivers (Burchell, Downs, and Mukherji, 2005). Brueckner (2001) and Wassmer (2000) explain that there is an important market failure associated with commuting because the social costs are greater than the private costs. The private costs of commuting include the costs of vehicle operation and the value of the time during the commute, but the presence of each additional driver on the road—though individually small—imposes a nonzero cost on society. Particularly, during peak hours, these costs may be quite large, resulting in delays.

Brueckner (2001) concludes that because these congestion costs are born by other than commuters, individuals generally would not take them into account when making driving decisions, resulting in overuse of publicly available road capacity. Further, Brueckner (2001) and Wassmer (2000) point out that most highways and other road infrastructure are unpriced, which provides no incentives for commuters to consider their use of infrastructure when making driving decisions. Commuting therefore appears artificially cheap and as long as demand slopes downward, the result is that roads are overused from a social perspective. As a result of these distortions, housing location choices that incorporate the full costs of commuting may be very different from choices when those costs are ignored. This creates the need for public policies to internalize externalities.

There are also other views of congestion, however. Burchell, Downs, and Mukherji (2005) say that " ... the most optimistic

TABLE 1
Commute Times in Select Inland Empire Municipalities 2001–2004

All Times and Distances to and from Route 710 in Los Angeles via the most Direct Freeway

		2001		2002		2003		2004	
Municipality	**Total Distance (Miles)**	**Time (a.m.)**	**Time (p.m.)**	**Time (a.m.)**	**Time (p.m.)**	**Time (a.m.)**	**Time (p.m.)**	**Time (a.m.)**	**Time (p.m.)**
Banning	78.42	82.34	82.06	86.11	85.76	85.21	86.43	83.37	92.03
Beaumont	73.13	77.80	77.12	81.57	80.69	80.68	81.41	78.84	86.88
Calimesa	66.44	72.07	70.87	75.84	74.27	74.94	75.07	73.10	80.37
Chino	28.92	36.78	44.94	38.38	44.44	40.53	45.97	37.69	45.53
Colton	49.06	57.10	54.50	60.86	57.43	60.03	58.51	58.14	63.28
Corona	42.74	63.08	64.82	54.30	59.33	53.71	58.87	51.27	61.54
Fontana	42.66	51.22	48.37	54.97	51.10	54.45	52.69	52.31	57.09
Grand Terrace	53.97	61.38	60.11	65.15	63.69	64.25	64.39	62.42	69.96
Hemet	80.48	86.66	96.96	88.08	99.86	88.59	100.02	87.31	99.03
Hesperia	74.02	80.01	79.20	81.26	80.80	89.69	88.79	84.49	85.96
Highland	59.92	66.48	64.77	70.25	68.02	69.35	68.89	67.52	74.02
Lake Elsinore	62.7	80.51	82.31	71.70	76.82	70.98	76.36	68.50	79.02
Loma Linda	51.96	59.66	57.54	63.43	60.70	62.53	61.60	60.69	66.66
Montclair	27.73	35.47	33.66	37.50	35.17	38.39	38.55	38.16	41.04
Moreno Valley	55.07	60.84	71.13	62.26	74.04	62.76	74.20	61.48	73.21
Norco	43.2	49.91	59.33	51.23	61.02	52.41	60.98	50.15	60.94
Ontario	30.26	37.97	36.13	39.96	37.69	40.70	40.93	40.70	43.51
Perris	64.37	68.81	79.11	70.23	82.01	70.73	82.17	69.45	81.18
Rancho Cucamonga	34.9	43.58	40.77	45.45	43.06	45.06	45.31	45.27	48.39
Rialto	44.94	53.17	50.71	56.92	53.58	56.40	55.11	54.26	59.66
Riverside	48.35	55.00	65.21	56.42	68.13	56.96	68.29	54.97	67.30
San Bernardino	53.71	61.16	60.57	64.93	64.55	64.06	65.15	62.18	71.23
Upland	30.26	37.97	36.13	39.96	37.69	40.70	40.93	40.70	43.51
Yucaipa	61.93	68.20	66.65	71.97	69.95	71.08	70.79	69.24	75.97

Source: Author calculations using PEMS data.

way to look at the inability to eliminate traffic congestion is to see it as a sign of success: it indicates economic activity and serves as a necessary balancing mechanism for a transportation system that could never be built to accommodate all peak-hour travel without delays.'' In fact, Burchell, Downs, and Mukherji (2005) come to the conclusion that even compact development would not reduce peak hour traffic congestion, though it would provide other benefits like lower fuel consumption and less air pollution. Cervero (2001) concurs with this conclusion, finding that across metropolitan areas congested freeways tend to be a consequence of strong economic performance. He not only finds an inverse statistical relationship between average travel speeds and productivity but also finds that metropolitan areas with better highway and road infrastructure perform better.

Two congestion measures used by the Texas Transport Institute are the average annual delay experienced per person due to congested roads and the ratio of time to make a given trip to the time under free-flow conditions. These measures are used by the Southern California Association of Governments (SCAG). Congestion can also be measured as the average speed of cars on a given section of freeway at a point in time, which is the approach taken by the Performance Measurement System (PEMS) used by the California Department of Transportation (Caltrans) to analyze the performance of freeways in California. PEMS data presented in Table 1 suggest that since 2001, in most areas, Inland Empire commute times have lengthened, in some cases very significantly.

The issue of congestion is especially important for the Inland Empire. SCAG estimates

that 2002 road congestion cost Southern California $12 billion, which is the most of any metropolitan area in the United States. Using data from the San Diego I-15 congestion pricing project, Brownstone et al. (2003) estimate that the median willingness to pay to reduce commute times is roughly $30/h, suggesting that traffic is a significant disamenity. Texas Transportation Institute (2005) ranked the Inland Empire as one of the most congested areas in the country and one that experienced large increases since 1980. Only Dallas, Washington, DC, and Atlanta had greater increases in hours of delay and of metropolitan areas classified as large (1–3 million residents); in 2005, the Inland Empire had the highest average delay (55 h). In comparison, Boston, San Diego, and San Jose averaged 51, 52, and 53 h, respectively. Leading the nation with an average 95 h was Los Angeles, followed by the San Francisco SMSA with 72 h. SCAG reports the 31 min average work commute time for Riverside County residents is the highest in Southern California. The average for Southern California is 28 min and the national average is 24 min (SCAG, 2001).

Economic theory suggests that increases in commute times inflate costs, reducing disposable income and utility. Because houses offer a bundle of characteristics (including transportation access), housing prices should be negatively affected by congestion. Among others, Boarnet and Chalermpong (2001) confirm this hypothesis and suggest that highway conditions influence development patterns through land prices. Reducing accessibility should therefore show up in lower equilibrium land prices for less accessible plots.

Associated with increased driving and traffic congestion is air pollution. It is particularly unfortunate that road traffic is so significant in Southern California because the air basin is especially prone to high concentrations of ground level ozone. High summer temperatures and westerly winds create particular problems for the Inland Empire, which experiences some of the highest average hourly and daily ozone concentrations in the country. Though air quality has improved dramatically over the past 20 yr, the South Coast Air Quality Management District (SCAQMD) reports that during 99 d in 2002, at least one monitoring station in the air basin exceeded the federal 8-h concentration standard of 0.085 ppm. In 2003, there were 120 violations. Valley and mountain areas of Riverside and San Bernardino Counties were responsible for over three-quarters of those exceedences (SCAQMD, 2004).

In 2003, Riverside and San Bernardino Counties also ranked first and second in the nation for total particulate pollution (California Air Resources Board [CARB] and American Lung Association of California, 2004). For example, at the Rubidoux monitoring station in Riverside, during the period 2000–2002, the average annual particulate matter $(PM)_{2.5}$ concentration was 28.9 $\mu g/m^3$, which is about 1.75 times the federal limit and more than twice the state standard. Maximum $PM_{2.5}$ concentrations at monitoring stations have been 80–100 $\mu g/m^3$, which are about 1.5 times the federal limit (CARB, 2003). Such concentrations are very common throughout the Inland Empire and have been constant since the late 1990s.

In terms of acute ozone exposures, which are known to significantly contribute to respiratory illness, the region has particularly serious and increasing problems. During 33 d in 2000, the federal hourly ozone concentration standard of 0.12 ppm was exceeded somewhere in the SCAQMD area. In 2001 and 2002, there were 38 and 40 overlimit days and in 2003, the region had 68 d above the federal hourly ozone standard.[5] The east San Bernardino valley exceeded acute exposure limits at least 21 d in 2001 and had a similar number of violations in 2002 and 2003 (Schexnayder, 2003; SCAQMD, 2004).

Such high concentrations are associated with inflated asthma rates (www.epa.gov), and in 1997, ozone was responsible for as many as 6 million asthma attacks nationwide and 159,000 emergency room visits (Jackson and Kochtitzky, n.d.). Pope et al. (2002) estimate that increases in $PM_{2.5}$ of 1.0 $\mu g/m^3$ increase mortality 0.4%–0.6%. For the case of diesel exhaust due to logistics industry expansion in the eastern Inland Empire, this translated into increased mortality of 25–35 persons per year (Bluffstone and Ouderkirk, 2007).

The second major potential failure is undervaluing open space. It is well known that open

5. Recently, the U.S. Environmental Protection Agency announced that in response to research showing that ozone is more hazardous to human health than originally thought, it would tighten the hourly standard to correspond with the 8-h standard. If this standard had been in effect in 2003, the region would have been out of compliance for approximately 135 d (www.epa.gov).

space, whether public or private, is highly valued (Irwin, 2002; Thorsnes, 2002). In the Inland Empire, protected areas and parks are less than in surrounding areas, and as development has accelerated, valuations have risen and more public open space has been created. For example, San Bernardino County recently established a 200-acre multiuse park in an attempt to preserve open space. This park was the first regional park established in 20 yr (Martin, 2003). Bluffstone and Fazeli (2002) found that residents of the City of Redlands were willing to pay approximately $54.00 per household per year to establish a state park in the San Timoteo Canyon. Even with the high land prices in Southern California, this willingness to pay was sufficient to fund the proposed 15,000-acre multiuse park, suggesting that the marginal value of open space may exceed the value of land for housing in some areas. In 2002, the core of this park was established.

At least partly responding to these valuations, in 2003, Riverside County approved $1 billion to purchase 153,000 acres of open space before it is engulfed by housing. This area will be added to about 350,000 acres of National Forest to create a series of wildlife corridors and natural preserves (Wilson, 2003a). This initiative is part of the county's multiple species habitat and conservation plan for protecting 146 species under the Endangered Species Act.

Finally, in order for housing development to occur, a variety of publicly provided infrastructure is required. Roads are needed to link developments with other parts of municipalities, sewage and water services must be provided, plus new residents require a variety of lumpy services, such as police and fire protection, parks, libraries, and schools. New development therefore imposes costs on local governments. Some of these costs would occur regardless of the spatial pattern of development, but dispersed development can also inflate costs. For example, developments that are far away from urban centers require more water and sewer piping and single-family houses need more piping than multifamily housing units, which share connections (Burchell, Downs, and Mukherji, 2005).

Somewhat surprisingly, in many cases, the tax and fee revenues generated by new development are insufficient to fund the public services they require. (Benfield, Raimi, and Chen, 2001). As Carrigg (2002) summarized the situation in California:

> City governments are being forced to play a game of fiscal "Twister" using mismatched revenue sources and strategies in an attempt to provide services for their residents. The result is a local finance system where there are insufficient revenues from new housing units to provide the additional services required by new residents.

In the past, some have argued that developing an area can increase the tax base. Studies done by the American Farmland Trust, however, suggest that farm and ranch lands require just 36 cents in services for every dollar of revenue raised. On the other hand, every dollar from residential development requires $1.15 in services. Inexpensive single-family homes use the most services for the least amount of tax dollars and as development spreads out costs rise. More compact development lowers the cost per housing unit (Burchell, Downs, and Mukherji, 2005).

V. HOUSING SHORTAGES AND AFFORDABILITY

The population of Southern California is forecast to increase from the current 16.7–23 million in 2025 (SCAG, 2001) and the Inland Empire is expected to absorb a significant share of that increase, with the population of Riverside County doubling by 2030 (Wilson, 2003b). This predicted population pressure begs the question of under what conditions those migrants will be housed, particularly in areas that have high social costs of additional development. Some argue that combating sprawl places restrictions on housing that will create or worsen housing shortages (Husing, 2005). Others, however, suggest that curbing sprawl means neither reductions in housing nor welfare. Much of this debate focuses on notions of "insufficient supply" and "shortage."

Critics of placing controls on growth in the Inland Empire point to the steep decline in new housing construction in California that started in 1986 and continued through most of the 1990s as a reason to reduce regulations despite likely increasing marginal external costs. In the 1980s, for example, Southern California produced approximately 1 million housing units, but during the 1990s, construction totaled only about 400,000 units. Most of the drop came from multifamily housing,

which declined from 470,000 units to only 120,000 units in 2000. California housing construction is now about 150,000 units/year, which is half the 1986 peak and 50,000 less than in the 1970s when the population was 10 million fewer. Single-family home construction in the 1990s was 27% lower than the 1980s (Kotkin, 2002).

The Inland Empire is bucking this statewide trend, partly relieving pressure in Los Angeles, Orange, and San Diego Counties, and as shown in Table 2, in most municipalities, substantially more building permits have been issued over time. Some argue that this building trend should be supported rather than curbed because land costs are lower than further west and the state as a whole is experiencing a housing shortage (Husing, 2005). The key question is whether controls that may slow down construction should be used to avoid even higher levels of public resource loss.

But it turns out that as is true for sprawl, the notion of a housing shortage is very poorly defined. In economics, we know that as long as prices are allowed to freely adjust, equilibria should be established in housing markets and no shortages should exist. The real concern is

TABLE 2
Building Permits Issued in Select Inland Empire Jurisdictions 2001–2004

	2001		2002		2003		2004	
City	Single-Family Units	Multifamily	Single-Family Units	Multifamily	Single-Family Units	Multifamily	Single-Family Units	Multifamily
Banning	319	0	388	166	548	0	310	2
Beaumont	447	0	522	0	1,137	0	1,206	0
Cathedral City	426	116	641	34	386	347	333	143
Chino	212	0	290	6	213	0	463	52
Chino Hills	422	0	250	240	294	450	191	0
Colton	146	0	65	0	42	0	77	0
Corona	1,090	0	699	0	366	422	620	0
Fontana	1,083	0	1,798	110	1,340	0	1,359	186
Hemet	451	8	338	44	798	4	804	68
Hesperia	540	13	469	0	965	123	1,478	129
Highland	265	0	289	0	366	0	297	0
Lake Elsinore	301	0	844	0	550	62	766	10
La Quinta	916	0	657	192	1,118	277	1,392	72
Moreno Valley	602	0	1,152	70	2,011	448	2,109	1,505
Murrieta	1,145	584	1,690	292	1,540	883	2,540	594
Ontario	151	144	76	86	90	102	133	851
Palm Springs	94	17	85	50	481	200	536	109
Perris	145	0	491	186	1,269	0	1,573	0
Rancho Cucamonga	980	1,256	1,410	692	1,175	779	1,059	2,508
Redlands	216	84	162	0	337	59	154	16
Rialto	90	4	99	0	121	4	63	33
Riverside	1,237	40	1,113	0	689	1,377	820	283
San Bernardino	144	75	310	75	185	0	318	6
San Jacinto	205	0	343	0	453	0	943	52
Temecula	944	0	651	0	1,087	326	888	408
Upland	41	0	96	0	233	0	98	0
Victorville	655	0	986	102	2,102	176	2,699	82
Unincorporated Riverside County	6,460	649	8,782	575	8,894	640	8,532	743
Unincorporated San Bernardino County	836	24	993	0	1,370	5	2,116	20

Source: Author calculations using data from SCAG.

therefore that people of modest means would not be able to afford to buy houses or, worse yet, could not rent accommodations. A standard way to approach this problem is therefore from the perspective of affordability (Johnson, Moller, Dardia, 2004), and generally, affordability is measured as the percentage of families that can afford the median priced single-family home. Alternative measures are the percentages of renters who face high rents and homeowners who face high mortgage burdens. Johnson, Moller, Dardia (2004) and Feldman (2002) note that paying more than 30% of income for housing is considered unaffordable. Southern California has some of the highest housing prices in the country (Southern California Studies Center, University of Southern California, and The Brookings Institution, 2001) and potentially as a result of these high prices, in 2002, metropolitan Los Angeles had the second lowest home ownership rate in the nation (49%), behind only New York City (Kotkin, 2002).

Feldman (2002), Downs (1992), Glaeser and Gyourko (2002), and Gellen (1982) suggest, however, that so-called housing shortages are not supply issues but instead are income problems. Growth advocates have, the argument goes, confused unaffordable housing with poverty and therefore mistakenly conclude that increasing housing supply is the solution. Looking at the United States and the Minneapolis/Saint Paul SMSA (a metro area believed to have a housing shortage), Feldman (2002), for example, finds that low incomes are the reason people live in unaffordable housing. Downs (1992) suggests that when looked at as an income issue, provision of rental vouchers would be the best way to attack the problem.

Glaeser and Gyourko (2002) remind us that housing supply restrictions can be identified when excess profits exist in housing markets, which would be indicated when housing is expensive relative to new construction costs. In such cases, barriers to entry must exist and a housing supply problem is indicated. Using 2000 Census data, the authors find that the average home price in the United States ($120,000) is very close to the cost of production. The authors conclude that housing shortages are not as bad as some would argue.

And since the 1980s real California house prices have declined. Adjusting for inflation, average home prices in California peaked in 1989, declined until 1996, and have since increased. The Public Policy Institute of California reports that despite rising nominal home prices in 2000, median prices in San Bernardino and Riverside Counties when adjusted for inflation decreased throughout the 1990s and were below the national average. In real terms, between 1980 and 2000, home prices in San Bernardino County decreased by 2% ($134,494–$131,500) and in Riverside County, prices only increased by 2% ($143,616–$146,500). From 1980 to 2000, only the San Francisco Bay area saw significant real increases in housing prices (Johnson, Moller, Dardia, 2004).

Also in terms of affordability, little has changed. The percent of San Bernardino and Riverside County residents spending more than 30% of income on rent fell marginally from 50% in 1990 to about 46% in 2000. San Diego and Los Angeles experienced similar declines. Rental vacancy rates in the Inland Empire (7.2% for Riverside and 7.3% for San Bernardino in 2000) were above the national average of 6.8%. On the other hand, Los Angeles (3.3%), Orange (3.0%), Ventura (3.6%), Imperial (4.9%), and San Diego (3.1%) Counties all had lower rental vacancy rates in 2000 (Johnson, Moller, Dardia, 2004). In year 2000, single-family vacancy rates in San Bernardino and Riverside Counties were 2.5% and 3.1%, respectively, which were above the national average

It turns out that even focusing on the supply of housing, the picture is quite murky. Johnson, Moller, Dardia (2004) test the hypothesis that macroeconomic factors, such as interest rates, growth and unemployment, and demographic factors, such as age, gender, and ethnicity, play significant roles in explaining annual changes in new housing construction. Unlike other studies dealing with the housing sector (e.g., Somerville, 1996), they look at both supply and demand factors that influence the housing market. They find that almost 80% of variation in new housing construction in California and 77% in the Inland Empire can be explained by macroeconomic and demographic variables. Adjusting for these factors, they conclude that housing availability today is probably better than in 1990.

Also of importance is that the California population grew more slowly in the 1990s than in the 1980s and household sizes increased.

While in the United States, average household size decreased from 2.75 people per household in 1980 to 2.59 in 2000, household size increased in California from 2.68 to 2.87 people. The Inland Empire also saw increases and average household sizes are larger than the national average. Most of this trend can be explained by factors such as age and ethnicity (Johnson, Moller, Dardia, 2004).

These results cast doubt on the notion that housing supply is somehow "insufficient" in California and probably weaken arguments that the social costs of new housing construction should be given less or no weight to "accommodate" growth. Indeed, demographic drivers could indicate different housing preferences than were previously observed or the problem could be low incomes. Further, there is little sense in attempting to overcome the effects of interest rates and unemployment by reducing key public resources in areas where those goods are already at low levels.

Russell (2003) indeed sees few fundamental conflicts between open space preservation and supply of affordable housing and notes that sprawl typically results from sources other than affordable housing construction. As already noted, in California and the Inland Empire, the huge majority of the decline in housing construction during the past decade was in terms of multifamily rather than single-family dwellings. Talbot and Costa (2003) point out that numerous California municipalities have used inclusionary housing policies that require fixed portions of new development to be affordable. They note that these policies have withstood court challenges by developers viewing such policies as illegal takings.

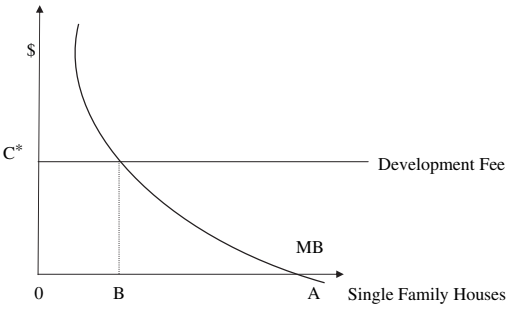
VI. THE USE OF PRICE INSTRUMENTS

The above discussion leads us to the issue of choosing instruments for internalizing the externalities associated with sprawling patterns of single-family home development. We do not attempt a comprehensive evaluation of instruments, but instead focus on the use of fees, which is a class of instruments that uses incentives to reduce negative externalities. Fees have been particularly used to control pollution (Bluffstone, 2003), and when applied to housing development are commonly called development impact fees (Brueckner, 1997).

Fees applied directly to environmental problems (e.g., air pollution, congestion, open space loss) are known to reduce social costs as long as the demand for the right to degrade those environmental services is not vertical. They are also known to allocate the burden for reducing those social problems at least cost (Bluffstone, 2003; Bluffstone and Larson, 1997; Kolstad, 2000). For example, a charge on individual tailpipe emissions could be set to reduce overall emissions by 25% and would distribute the economic burden of that reduction cost effectively across all drivers. The problem, of course, is that applying fees on emissions from such a diverse and mobile set of pollution sources would be difficult. As a result, less targeted fees that focus on goods *closely related* to tailpipe emissions tend to be used instead. For example, in Europe, gasoline taxes substitute for tailpipe emissions fees using the logic that such taxes will reduce driving and create incentives for more fuel-efficient vehicles, both of which are associated with lower tailpipe emissions.

Development fees could operate in a similar manner, targeting the social costs of sprawling development indirectly through fees on development itself. Figure 2 shows how this would work. With a charge rate of C*, development markets find it in their interests to pay the fee and develop houses as long as the MB of housing construction (net of any direct costs) exceeds the fee per house. This equilibrium is reached at Point B. If policymakers had a well-defined construction goal, they could use the fee to help achieve that goal. To maximize efficiency, development fees should be differentiated according to the marginal social

FIGURE 2
Development Fees and Single Family Home Construction



costs of each development rather than being the same for all classes of development.

Ihlanfeldt (2004a, 2004b) defines development fees as one-time levies charged for the provision of infrastructure services such as water and sewer, schools, and other municipal amenities, such as roads, police and fire protection, and parks. Public infrastructure costs of new development have traditionally been financed using property taxes, which as discussed by Brueckner (2001) imply a marginal price of zero for the right to use public infrastructure. This causes development to appear artificially cheap and results in overdevelopment and sprawl. Tax revolts such as Proposition 13 in California increased interest in the use of development fees (Ihlanfeldt and Shaughnessy, 2004), and California was one of the first states to adopt development fees (Clarke and Evans, 1999).

In the Inland Empire, fees are charged for water/sewer, schools, and municipal services such as libraries, street trees, and parks. Additional fees are levied for engineering reviews, inspections, etc., that are not considered here. In the Inland Empire, development fees averaged $15,174 per house in 2002 but were as high as $25,854 in the town of Fontana and as low as $5,646 in Yucca Valley. School and water/sewer fees were approximately equal and on average totaled $12,694 of the total fee. So-called "impact" fees focusing on other municipal services were just more than 16% of the average fee (Bluffstone, 2005).

It is notable that Ihlanfeldt and Shaughnessy (2004) define development fees as applying exclusively to the infrastructure costs of development rather than *all external costs of development*. This is not an omission, but instead reflects the reality that applying development fees to noninfrastructure social costs is generally considered an illegal taking. During the 1990s, for example, the U.S. Supreme Court handed down 11 rulings that supported the property rights of developers over the rights of municipalities to restrict growth. As Patterson (1999) notes:

> A well-financed movement has emerged that is dedicated to expanding the scope of the takings clause of the US Constitution from a "physical taking" of property to "over-regulation" of property that diminishes its value.

Due to state and federal court rulings and legislation, a so-called "rational nexus" test of development fee legality is generally used. This test requires that fees be proportional to the costs of providing services and migrants must benefit from the infrastructure financed (Ihlanfeldt and Shaughnessy, 2004). Though in principle, all costs can be charged—and the economics literature is very clear they *should* be charged—in practice only direct infrastructure costs associated with new development can be considered.[6] The effect of this widely accepted, but from a standard economic perspective, restrictive interpretation of development fees is to make municipalities very wary. Development fee ordinances are regularly disputed in court and often suits are successful. For example, in Ehrlich v. City of Culver City, the Supreme Court of California ruled the city failed to show proportionality and a $280,000 impact fee was disallowed (Daily Journal, 1996). This meant that despite generating social costs, developers may have not paid Culver City for development rights.

The potential for court challenges is also perhaps the main reason municipalities in Southern California often end up covering substantial portions of the direct public sector costs of development. Indeed, with property taxes capped by Proposition 13, which was approved by voters in 1978, in the Inland Empire, houses costing less than $250,000 are net drains on municipal budgets.[7] Far from internalizing all external costs of development, in reality fees may not even cover the total direct costs of serving developments.

Much of the empirical research on development fees has focused on incidence and effects on real estate markets. The traditional view is that they are like other taxes and therefore generate deadweight losses due to depressed prices of undeveloped land, inflated new housing prices, and lower consumer and producer surpluses (Ihlanfeldt and Shaughnessy, 2004). Underlying this view presented by Delaney and Smith (1989a, 1989b) among others is

6. The APA policy guide on fees notes that the Association supports the use of fees, but only insofar as they relate to direct infrastructure costs, and where a rational nexus can be demonstrated. The guide also specifies that "a fee cannot be imposed to address existing deficiencies except where they are exacerbated by development." They also "cannot exceed the cost of the improvements" and "cannot cover normal operation and maintenance or personnel costs, but must be used for capital improvements . . ." (www.planning.org/policyguides/).

7. We gratefully acknowledge former City of Redlands Mayor *pro tem* and council member, Gary George, for providing this and other insights.

the assumption that the demand for housing is downward sloping. This implies that in the short-run developers and new home buyers share the burden of any fee and the decline in the prices received by developers is less than the fee. In addition, some home buyers who would have bought a new home will instead buy an existing one, driving up prices.

An alternative hypothesis presented by Yinger (1998) and supported empirically by Ihlanfeldt and Shaughnessy (2004) supposes that fees are used to improve infrastructure serving houses. We can also think of them as potentially improving public goods that generate a variety of amenity values (e.g., better policy, open space, air quality) that are capitalized into house prices. Further, with mobile households and closely substitutable communities available, development fees are not shifted to new home buyers as would be the case with other taxes and indeed have no effect on house prices. Only the benefits from the new and better municipal infrastructure (and in principle reduced congestion, better air quality, and increased open space) affect new home prices. Ihlanfeldt and Shaughnessy (2004) find that in Dade County, Florida, a $1.00 increase in fees spurred an increase in housing prices of $1.60. This suggests that home buyers value the public services and resources bought with fees more than their costs. Effects on land prices may be positive or negative and depend on the value home buyers place on infrastructure improvements bought with development fees. Yinger (1998) finds, though, that landowners are most likely to bear any burden of development fees.

VII. CONCLUSIONS

The literature indicates that sprawling patterns of development, such as those observed in many parts of the Inland Empire, generate serious external costs, but these costs may be poorly defined and difficult to quantify. Probably, partly because of these difficulties, sprawl itself is poorly defined. Yet, certain costs are well established and therefore should provide a well-defined focus for policy changes. The literature, for example, suggests that air pollution and congestion linked to sprawling development patterns impose enormous time and human health costs, and standard economic theory is very clear that to not internalize those costs using public policies will result in social losses. Similar conclusions can be drawn for the loss of open space, which is the second well-defined cost of sprawl, particularly in regions like the Inland Empire where it is quite scarce. Needless to say, housing markets should cover the costs of the public infrastructure and services needed by new residents, as well as any infrastructure costs imposed on the rest of society, but this is a bare minimum step toward efficiency. Unfortunately, at present, only the most direct infrastructure costs can be charged to housing and land markets.

These negative externalities from housing development leading to sprawl should be internalized through policies regardless of conditions in housing markets and we should be particularly careful not to confuse housing supply issues with other social problems, such as low incomes. Evidence on the existence of housing supply problems and shortages is very weak and such concerns should not be used as excuses to avoid the use of public policies that would cause new single-family home buyers and sellers to face the full social costs of their actions. Multifamily dwelling construction—which has seen a precipitous decline in California during the past 20 yr but is in general unrelated to sprawl—would in any case be the most appropriate way to address inadequate housing for poorer people; more affluent residents and migrants are certainly not seriously in need of housing support.

The costs of sprawl could be internalized using development fees and such instruments have been widely applied to pollution. For example, it is very standard to estimate that a proposed development would generate X vehicle trips per day, which would increase ozone concentrations by y $\mu g/m^3$. Given the enormous epidemiological and valuation literatures on mortality and morbidity due to air pollution, the external costs associated with these increased concentrations can be estimated. Based on these estimates, fees could be charged that internalize those costs. Such estimates, for example, have been made for $PM_{2.5}$ pollution due to logistics industry growth in the Inland Empire leading to specific recommendations for fees on warehouse facilities (Bluffstone and Ouderkirk, 2007).

Price policies are potentially powerful instruments for controlling sprawl but legal barriers obstruct anything close to optimal fee implementation. Municipalities seeking

to defend themselves from sprawl and force development markets to pay their way may find themselves defending their actions in court. Small jurisdictions may find such burdens too onerous and could be forced to allow development markets a relatively free pass. This is perhaps one of the key policy problems associated with sprawl today. Ways to overcome the legal barriers to getting the price of development right should therefore be sought.

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