An Empirical Investigation of the Effects of
Impact Fees on Housing and Land Markets

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and

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Abstract

This paper presents the results from estimating the effects of development impact fees on the prices of new and existing single-family homes and undeveloped residential land using unique data for Dade County, Florida. The results show that an additional $1.00 of fees increases the price of both new and existing housing by about $1.60 and reduces the price of land by about $1.00. These findings are shown to be consistent with the new view but not the old view theory of impact fee incidence.

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Introduction

An increasing number of local communities in the United States have sought alternatives
to the property tax as a means of financing capital improvements or other expenditures.
Prominent among these are developmental impact fees, which are one-time levies
assessed on property developers ostensibly for the provision by the local government of
such infrastructure services as roads, schools, parks and other recreational areas, library
services, and fire and police protection for the additional population that is caused by the
development. States and their local governments have varied as to their use of impact
fees, with certain states, such as Minnesota, California, Florida, and Colorado, taking the
lead in their adoption.

Impact fees are growing in popularity for at least two reasons. First and foremost,
property tax financing of the public capital services (or infrastructure) required by new
development increases the tax burdens of existing property owners. By switching to
impact fees, these costs are shifted to property developers.[1] Second, to the extent that
impact fees approximate user fees, they are both more efficient (since investment
decisions reflect marginal social cost) and more equitable (based upon the benefit
principle of just taxation) than alternative financing mechanisms.[2]

Despite the spread of impact fees, their effects on land and housing markets have
received comparatively little empirical investigation. Most importantly, not much is
known regarding the economic incidence of impact fees—i.e., who is it that actually
bears the burden of the fees—developers, new homebuyers, or owners of undeveloped
land? How the burden of the fees is distributed across these groups has a bearing on a
number of issues currently receiving considerable attention in policy discussions,
including the availability of affordable housing for lower-income households in job-rich
suburban communities and the negative externalities that allegedly result from suburban
sprawl.

A few studies have investigated the effects of impact fees on the sales prices of new and
existing single-family homes. However, the reliability of the evidence presented by these
studies is questionable because it is generally not consistent with expectations derived
from economic theory, and emanates from sparsely specified hedonic price models that

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[1] Assuming that competition ensures normal profits in the housing construction industry, developers will
recover these costs in the form of higher housing prices or lower land prices, as discussed more fully in the
next section.

[2] State legislatures and state courts have typically applied the "rational nexus" test to impact fee ordinances,
which requires 1) a clear connection between new growth and the need for new capital facilities, 2) fees
that are proportional to the costs of providing the facility, and 3) the payer of the fee benefit from the new
public facilities.

omit variables that are likely correlated with impact fees. Perhaps an even more significant limitation of the extant literature is that there is little evidence on the impact that fees have on the value of vacant land, despite the fact that economic theory suggests that landowners may be heavily impacted by fees.

This paper presents the results from estimating the effects of impact fees on the prices of new and existing single-family homes and undeveloped residential land using unique sets of time-series data for Dade County, Florida.[3] The first impact fee adopted by Dade County was in 1989 and was earmarked for road construction. Since then the total amount of fees has grown as fees for parks, education, fire protection, and police protection were added and existing fees increased. We relate the growth in fees to changes in constant-quality new and existing house price indices and indices of the value of undeveloped residential land by estimating stock-flow models of the housing and land markets.

Our results show that an additional $1.00 of impact fees increases the price of both new and existing housing by about $1.60 and reduces the price of land by about $1.00. The uniform effects of impact fees found for new and existing housing and our finding that the magnitude of these effects are roughly in line with property tax savings experienced by homeowners are consistent with the new view theory of impact fee incidence. The finding that land values fall, despite the fact that the increase in new home prices exceeds the total value of the fees, can be attributed to developer uncertainty regarding future increases in fees.

The Theory of the Incidence of Impact Fees

The theoretical literature on the incidence of impact fees can be divided into an old view (Altshuler and Gómez-Ibáñez 1993; Delaney and Smith 1989a, 1989b; Downing and McCaleb 1987; Snyder 1986; Huffman, et al. 1988; Singell and Lillydahl, 1990) and a new view (Yinger, 1998a, 1998b).[4] The old view treats impact fees as an excise tax on developers, ignoring the new public capital services (or infrastructure) that are financed by the fees. Hence, under the old view, the imposition of an impact fee in a competitive market results in the standard short-run excise tax effect: the supply of new housing shifts up by the amount of the fee, resulting in a higher price paid by new homebuyers, a lower net price received by developers, and a lower quantity of new homes built. An underlying assumption of the old view is that the demand for housing is not perfectly elastic.

Based on the assumption that supply and demand are neither perfectly elastic nor perfectly inelastic, the old view predicts that the increase in the price of new homes and the decline in the net price received by developers will both be less than the amount of the fee. In the short-run, therefore, both the new homebuyer and the developer share the burden of the fee—the new homebuyer in the form of a higher price and the developer in

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[3] Dade County encompasses the entirety of the Miami, Florida Primary Metropolitan Statistical Area. Dade County along with Broward County form the Miami-Ft. Lauderdale Consolidated Metropolitan Statistical Area.

[4] Our review of the theoretical literature provides a brief, intuitive account of the principal predictions of each theory. For diagrams and mathematical formalizations, see the articles referenced.

the form of economic losses. Because new and existing housing are close but imperfect substitutes, the old view also predicts that impact fees will cause some homebuyers who otherwise would have purchased a new home to instead buy an existing home. This shift in demand in favor of existing homes will increase their price by something less than the increase in the price of new homes.

In the long run, developers' profits return to a normal level as their bids for land decline, resulting in reductions in the price of land. Thus, part of the burden of the impact fee is shifted backward to landowners. Huffman, et al., however, argue that backward shifting is highly unlikely because landowners have a reservation price below which they will not sell, and they will keep their land off the market until prices rise to that level. This argument is not persuasive. While the existence of a reservation price may make land prices sticky in a downward direction in the short run, it does not eliminate the possibility that impact fees will be shifted backward. In a depressed market with reduced housing construction, reservation prices eventually decline in the absence of buyers.

The chief differences between the old and new view theories of impact fee incidence are that the new view 1) incorporates the public capital services that are financed by the fees, 2) recognizes the impact of property tax capitalization on the incidence of the fees, and 3) assumes that the housing demand curve facing construction firms in a single jurisdiction is horizontal. The latter assumption is equivalent to assuming that new homebuyers are mobile.[5] Yinger (1998b) argues that the old view's reliance on downward-sloping demand rests upon faulty reasoning:

> However, the motivation for downward-sloping demand in the literature is not clear. In particular, most of the articles in the literature argue that demand will slope downward in a community that has nonreproducable characteristics or no close substitutes. With mobile households, however, the value of nonreproducable characteristics will simply be capitalized into the price of housing—with no impact on the slope of the demand curve. (p. 31)

Because new homebuyers are mobile, impact fees are not shifted forward to them under the new view (i.e. the imposition of the fee has no direct effect on the price of housing). However, the benefits that accrue to new homebuyers from the infrastructure financed from the fee are capitalized into new home prices. If the increase in price that results from the capitalization of benefits equals the fee, then neither the developer nor the landowner bear any burden of the fee since developers' profits remain at the normal level. The fee is borne by the homebuyer in the form of a higher housing price, but net of the benefits received from the fee-financed infrastructure there is no burden. However, if these benefits are less valued by the new homebuyer and therefore result in a house price increase that is less than the fee, restoration of developers' profits to a normal level

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[5] The most convincing evidence on the rate of property tax capitalization is provided by Yinger, et al. (1988), who find that property taxes, holding services constant, are fully capitalized into house values.

requires that the price of land declines.[6,7] On the other hand, if the benefits from the new infrastructure are highly valued by new homebuyers and as a result the increase in the price of housing exceeds the amount of the impact fee, then normal profits for developers requires an increase in the price of land. Land prices therefore remain unchanged, decrease, or increase depending upon whether the benefits of the new infrastructure are equal to, less than, or greater than its costs, assuming that these costs are fully covered by the impact fees.[8]

The above effects assume no change in the property tax rate. However, the increase in house values due to the infrastructure improvements raises the property tax base in the jurisdiction and increases the revenue that can be raised at the old tax rate. Hence, assuming the maintenance of a balanced budget, the tax rate must fall. This fall in the tax rate has two implications. First, it will increase the price of new housing and therefore further compensate developers for the fee they must pay. This lessens the possibility that the fee will be shifted backward to landowners. Second, the fall in the tax rate extends to existing homeowners a capital gain from the imposition of the fee.

Because almost all local jurisdictions have relied upon the property tax to finance new public capital services, the predictions of the new view regarding a shift from property tax finance to the use of impact fees is of particular interest. Assuming there is no change in infrastructure quality that accompanies the change in financing, the new view predicts that the price of new and existing housing should both go up by the same percentage. The increase in house prices should equal the capitalized value of the property tax savings that homeowners expect from the reduction in the tax rate. The tax rate declines because the imposition of the impact fee shifts the costs of new infrastructure from existing property owners to developers. If the increase in the price of housing from the expected property tax savings is less (more) than the fee, the price of land must decline (rise) to maintain developer profits at the normal level.[9]

The prediction of the new view that land values will not fall if the property tax savings-induced increase in the price of new housing equals or exceeds the fee is based on the assumption that developers expect fees to remain unchanged in the future. However, an increase in fees may cause developers to expect that new types of fees will be added in the future (e.g., a road fee may signal that an education fee is forthcoming) or that existing fees will go up. Because there can be significant time delays between the purchase of land and the approval of building permits (the time at which fees must be

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[6] This assumes that there is perfect competition in the construction industry. In most markets, especially in large markets like Dade County, this assumption is likely satisfied, since the construction industry is characterized by numerous small and independent contractors.

[7] Benefits from the new infrastructure financed by the fees may not be highly valued by new homebuyers if the infrastructure is deemed unnecessary (e.g., a new school by households without children) or if the infrastructure serves both new and existing residents and consumption is rivalrous.

[8] This is only approximately correct. As Yinger (1998b) notes, even if benefits equal costs, an impact fee is expected to reduce the price of land because developers cannot fully recover the fee in the form of a higher housing price: as price increases, property taxes also go up, which dampens the increase in price.

[9] The property tax savings will of course be larger within those jurisdictions that contain a higher percentage of new households.

paid in Florida), expectations of higher fees may lower developers' land bids in the current time period even if during this time the rise in housing prices matches or exceeds the fee. Developers are more likely to form these expectations of future higher fees when the jurisdiction's decisions to implement or raise fees are unpredictable.

In summary, the old and new view theories of impact fee incidence yield the following contrasting predictions regarding the price effects of impact fees:

- The old view predicts that the price of new homes will increase by less than the fee. Assuming no change in infrastructure quality, the new view predicts that the price of new homes will increase by less than or more than the fee, depending upon the property tax savings that homebuyers expect from the change in financing.
- The old view predicts that the price of existing housing will increase by something less than the increase in the price of new homes. The new view predicts that the price of new and existing housing will increase by the same amount and this amount will equal the capitalized value of the property tax savings that homeowners expect.
- The old view predicts that in the long-run land owners will bear part of the burden of the impact fee in the form of a reduction in the price of land. The new view predicts that the price of land will fall or rise depending on whether the property tax savings-induced increase in the price of new housing is less than or more than the amount of the fee.

A Review of the Empirical Evidence on the Incidence of Impact Fees

Early empirical analyses of the incidence of impact fees consist of papers by Delaney and Smith (1989a, 1989b), Singell and Lillydahl (1990), Nelson, et al. (1992), and Skaburskis and Qadeer (1992). Table 1 summarizes the resulting fee effects of these papers. Delaney and Smith study the effects of a $1,150 impact fee that was adopted by Dunedin, Florida in 1974. Their two papers look at the effects of the fee on the price of new housing and existing housing, respectively. In their analysis of new housing, they first construct annual indexes of the price of "constant-quality" housing for the years 1971-1982 for the city of Dunedin and three nearby cities that had not adopted an impact fee over the study period or had adopted only a small fee. These indexes are based on regressing the sale price of new homes on square footage, lot size, and land cost per square foot for each city and each year. To form the indexes a house with mean characteristics was priced in each city/year by using the estimated coefficients obtained from the hedonic regressions. The ratio of the index for Dunedin to the index for one of the comparison cities was then regressed on a dummy variable that is one in those years impact fees are expected to influence new house prices in Dunedin. In all three comparisons, the estimated coefficient on the impact fee dummy variable is at least three times as large as the value of the impact fee, indicating significant "overshifting."

In their second paper, Delaney and Smith construct constant-quality price indices, in the same fashion as in their first paper, for new and existing housing in Dunedin and existing housing in the nearby city of Clearwater. Clearwater had no or very small impact fees in

the years covered by the study, 1971-1982. As in their first study, they use ratios of indices as their dependent variables: 1) the ratio of Dunedin's existing house price index to its new house price index, and 2) the ratio of Dunedin's existing house price index to Clearwater's existing house price index. Regressions of these ratios on the impact fee dummy variable show that the price of new housing rose relative to the price of existing housing in Dunedin and that the price of existing housing in Dunedin rose relative to the price of existing housing in Clearwater after Dunedin's impact fee was adopted.

The papers of Delaney and Smith suggest that impact fees increase the price of both new and existing housing, but the effect is larger on new housing. Their finding that impact fees have a larger price effect on new than existing housing is more consistent with the old than the new view theory. However, overshifting is not predicted by the old view, but is possible under the new view. As discussed in the previous section, if the impact fee is an excise tax, the price of new homes should increase by less than the fee. Under the new view, if property tax savings are large enough, the price of new housing can increase by more than the fee.

The conclusions of Delaney and Smith have been contested by Yinger (1998b), who expresses two criticisms of their methodology. First, in constructing their price indexes they held the price of land constant, which means that any backward shifting of the fee to landowners is not captured, thereby possibly overstating the amount of forward shifting.[10] Second, the hedonic models they estimate to construct their prices indexes are subject to omitted variable bias since their data set did not allow them to control for infrastructure quality or for housing and neighborhood characteristics.

Singell and Lillydahl use housing price data from Loveland, Colorado that spans a three-year period (1983-1985), in the middle of which $1,182 of additional impact fees were implemented. They estimate separate models for new and existing housing and regress the log of house value on the log of the interest rate, the log of five variables describing the house (square footage, number of bedrooms, number of baths, lot size, and house age), a time trend, and a dummy variable that equals one for months in which the new fees were in effect (with a three-month lead).[11] They find that the $1,182 increase in fees increased the price of new homes by $3,800 and the price of existing homes by $7,000. None of these results is consistent with either the old view or the new view theory. The new view indicates that impact fees should increase the prices of new and existing homes by the same amount; hence, Yinger (1998b) questions the divergent findings between new and existing housing found by Singell and Lillydahl. He also finds the magnitude of the effects implausibly large. He suggests that quality was probably declining for the new houses in Singell and Lillydahl's sample, which would explain the small effect found for

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[10] Yinger notes that the failure of Delaney and Smith to allow for the price increase for new housing to be accompanied by a decrease in the price of undeveloped land likely explains their result in their second article that the fee increases the price of new housing relative to the price of existing housing. As reviewed in the theoretical section, Yinger's model indicates that the fee should have the same effect on new and existing house prices.

[11] A three-month lead is used since, in an earlier hedonic model without impact fees as a control variable and including a vector of monthly dummy variables, the coefficients on the month dummy variables show a spike in house prices three months prior to the date the fee increase became effective.

them, and that some time-related factor was left out of their models that pushed up the price of both new and existing homes at about the same time the increase in fees occurred.

The only studies that have estimated the effect of impact fees on land values are Nelson, et al. (1992) and Skaburskis and Qadeer (1992). Nelson, et al. use data on developable land sales in Loveland, Colorado and Sarasota County, Florida. Within the Loveland sample impact fees vary over time, while for Sarasota fees vary across the county, with fees of varying amounts applicable to properties located within two municipal service taxing units and the nonexistence of fees outside these areas. Nelson, et al. regress land prices on an impact fee variable and a number of control variables. Their results differ between the two cities: for Loveland the fee variable is statistically insignificant, while for Sarasota the fee variable is positive and significant. For the latter result, which is inconsistent with the old view, the authors provide two possible explanations: 1) where fees exist the expectations of developers may be more certain that the necessary infrastructure improvements will actually be provided by the county, and 2) where fees exist building permits may be faster to obtain.[12]

The models estimated by Nelson, et al. have been criticized by Yinger (1998b) as subject to endogeneity bias, because the unit of land measurement appears on both sides of their estimated equations. An equally important reason for questioning their results is that their sample sizes are exceedingly small, ranging between 29 and 40 observations.[13] Finally, the explanations they provide for why the fees are found to increase land prices suggest that developers would favor fees, which is not consistent with the efforts that Florida home builders have made to eliminate them (Bousquet, 1999; Charles, 2000).

Skaburskis and Qadeer use data on 1,021 single-family lot sales from three of Toronto's suburban municipalities over the period 1977-1986.[14] They regress lot price on variables measuring impact fees and other development costs, the distances of the lot to major employment centers, and expected future growth in housing prices and construction costs. Like Nelson, et al., they find that fees increase lot prices; specifically, fees increase lot price by approximately 1.2 times the size of the fee. Their explanation for this finding is that impact fees delay development which increases housing prices, which in turn raise land prices. According to the new view theory of impact fee incidence, rising house prices can only raise land value if the increase in house price exceeds the amount of the fee, but no evidence is provided by the authors on whether this condition was satisfied for their sample. Without such evidence, it is unclear whether rising housing prices account for their results.

In addition to the early studies, there are two recent studies that have had the benefit of Yinger's new view theory and his critique of the early literature (Dresch and Sheffrin,

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[12] No evidence is provided by Nelson, et al. that fees actually changed the expectations of developers or increased the speed of permitting.
[13] The small size of the Sarasota sample is even more problematic in light of the 16 independent variables entering the model.
[14] In his review of the empirical literature, Yinger overlooked Skaburskis and Qadeer's study.

1997; Baden and Coursey, 2002).[15] Dresch and Sheffrin use housing sales data for Contra Costa County (a county in the San Francisco Bay area) for the period 1992-1996. They estimate separate hedonic price equations for the eastern and western areas of the county and for new and existing homes. In addition to an impact fee variable, their models include property descriptors (but no locational or neighborhood characteristics) and jurisdictional dummy variables. The inclusion of the latter dummy variables means that intertemporal variation in fees within jurisdictions is relied upon to estimate fee effects. The results show that in the eastern area of the county an additional $1.00 of fees increase the price of new and existing housing by $0.25 and $0.23, respectively. In the western area of the county the same $1.00 fee increase causes the price of new housing to increase by $1.88. The results for existing homes in the western area are not reported but are said to show no relationship between fees in a jurisdiction and the sale price of existing homes.

Dresch and Sheffrin's eastern area results could possibly be explained by either the old or new view theories. But the inconsistency in their results between the eastern and western areas cannot be explained by either theory. The overshifting in the western area is inconsistent with the old view, while the large difference found in the increase in the price of new housing between the two areas could only be explained by an implausibly large difference in the elasticity of demand. Under the new view, there is no reason to expect differences between the eastern and western areas unless homebuyers expect different tax savings between the two areas, which is also implausible given they are located within the same political jurisdiction.[16] The finding that impact fees affect the price of new housing but not the price of existing housing within the western area is also inconsistent with the new view.

Baden and Coursey use 1995-1997 housing sales data from eight suburban municipalities located in the Chicago metropolitan area. They estimate a model that is similar to that of Dresch and Sheffrin, except that they choose to pool new and existing home sales and estimate a single model for the entire housing market. Using a double-log model they obtain elasticities that fall within a range of .011 and .014. These elasticities indicate that for the average priced home within each jurisdiction the increase in housing price tends to match the increase in fees. Because separate models are not estimated for new and existing houses, it is difficult to assess Baden and Coursey's results in light of either the old or the new view theory, but the magnitudes of their estimates are more reasonable than those obtained in the early studies. However, as in all previous studies, they too omit neighborhood and locational variables (other than jurisdiction dummies) from their estimated hedonic models.

In summary, many of the estimated price effects of impact fees reported in the extant literature are not consistent with theoretical expectations, regardless of whether these expectations are based on the old or new view theories of impact fee incidence. This is

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[15] Dresch and Sheffrin cite a 1996 mimeo by Yinger that is an early draft of his subsequent 1998 articles, and Baden and Coursey cite Yinger (1998b).

[16] Due to Proposition 13 the expected savings are unlikely to be in property taxes but rather in the "special taxes" that are used in Mello-Roos districts to finance infrastructure.

not surprising in light of the underspecified models that have been estimated. In the Methodology section we outline an empirical approach that attempts to overcome the limitations of prior work.

Issues Relevant to Dade County as the Study Area

Dade County encompasses the entirety of the Miami, Florida Primary Metropolitan Statistical Area. Dade County along with Broward County form the Miami-Ft. Lauderdale Consolidated Metropolitan Statistical Area. A distinguishing characteristic of the new view theory is that new homebuyers are assumed to be mobile across political jurisdictions, and therefore the housing demand curve facing construction firms in a single jurisdiction is horizontal. This assumption might be questioned in our application because our single jurisdiction represents the entire Miami PMSA. The issue is whether Dade County is its own housing market or part of a larger housing market. There has been considerable debate in the housing literature on the geographical extent of the housing market.[17] Some studies have gone so far as to conclude that there is a single national housing market (Linneman, 1980, 1981; Cobb, 1984; Deyak and Smith, 1974; Smith and Deyak, 1975), based upon the argument that residential migration and housing capital funds are sufficiently mobile that arbitrage across geographical areas within the United States creates an efficient housing market. It is beyond the scope of this paper to investigate the size of the housing market that includes Dade County. However, there is evidence that suggests that Dade is part of a larger market. If there are at least some consumers who would consider the alternative areas, then those areas can be treated as a single market (Palmquist, 2000). The two counties that share a long common border with Dade are Broward to the north and Monroe to the west. According to the 2000 Census, 115,044 and 1,186 of the people who work in Dade live in Broward and Monroe, respectively. While each of these counties also impose impact fees on new homes, the amounts of the fees are only about one-third as large as those in Dade County.

Another issue that is relevant to our use of Dade County as our study area is that the quality of the public infrastructure provided to purchasers of new homes cannot be measured. If infrastructure quality changes over time and these changes are correlated with changes in impact fees, then our estimates of the price effects of impact fees may be biased. However, it is clear from Dade County's impact fee ordinances that the intent of the County is to use the fees to provide capital services to new residents commensurate with those provided to existing residents. Hence, while we cannot rule out an omitted variable bias in our results, it has not been Dade's policy to accompany changes in fees with either increases or decreases in the quality of infrastructure provided to new homebuyers. Rather, the goal has been to find a revenue source that would take pressure off the property tax as a means of funding the infrastructure needs of a rapidly growing population.[18,19]

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[17] For review of this debate see Linneman (1982) or Palmquist (1991).

[18] It should also be noted that our results suggest that the omission of infrastructure quality has not biased our estimated impact fee effects. As discussed below, we find that the fees increase the price of new and existing housing by the same amount, which is consistent with the new view theory. If changes in the

Methodology

Our empirical approach to the estimation of the price effects of impact fees consists of two stages. In the first stage monthly indices of the price of constant-quality new and existing housing and undeveloped residential land are constructed. These indexes are regressed in the second stage on impact fees and a set of control variables suggested by DiPasquale and Wheaton's (1994, 1996) stock-flow model of the housing market.

First stage

To construct our constant-quality price indexes we first estimate both hedonic price and repeat-sales models. The estimated coefficients obtained from the hedonic models are then used to predict the price that a property with mean values of the independent variables would sell for in each month. These monthly predictions form one of the two types of price indexes we construct. The other type comes from the estimation of repeat-sales models. The estimated coefficients of these models directly provide a cumulative price index that measures the percentage change in price between period t and the initial time period.

For new housing only a hedonic price model can be estimated, but for existing housing we estimate both hedonic and repeat-sales models. For reasons given below, only a repeat-sales model is estimated for vacant land.

The hedonic model estimated for new single-family home sales can be expressed as:
$$P_{i,t} = \beta_0 + \beta_1 S_i + \beta_2 N_{i,t} + \beta_3 L_i + \beta_4 J_i + \beta_5 T_t + u_{i,t} \tag{1}$$
where $P_{i,t}$ = sale price of house i in time period t
S_i = structural characteristics describing house i
$N_{i,t}$ = characteristics of house i's neighborhood in time period t
L_i = the distance and distance squared between house i and eight different
employment centers
J_i = dummy variables indicating which of 32 jurisdictions the house is located in
T_t = dummy variables for the time period (month and year) the house was sold
$u_{i,t}$ = regression error term

To estimate (1) our primary data source is the Dade County Property Appraiser 2001 tax roll. Along with sales price information, the tax roll provides structural characteristics on all properties and a parcel identification number that allowed us to pinpoint each property's location on a digitized map. GIS applications were used to assign each

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quality of infrastructure provided to new homes are correlated with changes in fees, we would expect that the price effects of the fees would differ between new and existing homes.

[19] Like most local jurisdictions Dade County relies on a wide variety of methods to finance its capital expenditures, but the dominant method is to issue long-term municipal bonds and pay the debt service on these bonds using property tax revenues.

property to a census block group and to measure its linear distance to eight different employment centers within the Miami metropolitan area.[20]

The S variables include the number of bedrooms and baths, interior living area in square feet and its square, and the size of the lot in acres and its square.[21] The N variables included, for the block group, median income, percent black, percent Hispanic, and percent renter.[22] The time period (t) in (1) is the month and year the house was sold. The first period is January 1985 and the last period is December 2000, thus resulting in a set of 191 T dummy variables representing 192 months.[23]

The hedonic model estimated for existing houses is identical to (1), except that the age of the house and age squared are included as explanatory variables. The new and existing housing models contained 39,792 and 107,376 individual sale price observations, respectively.[24] The results from estimating the hedonic models show that they have good explanatory power (R^2 = .79 for existing housing and .83 for new housing) and that the explanatory variables all behave in the expected fashion.[25]

For existing housing and vacant residential land we estimate a standard repeat-sales model:

$$\ln\left(\frac{P_{i,t}}{P_{i,t-n}}\right) = \sum_{k=1}^{T}\beta_k D_{i,k} + \varepsilon_{i,t,t-n} \tag{2}$$

where $P_{i,t}$ is the most recent selling price of property i at time t; $P_{i,t-n}$ is the previous selling price of property i at time t-n; β_k is the logarithm of the cumulative price index in period t; $D_{i,k}$ is a dummy variable which equals –1 at the time of the initial sale, +1 at the time of the second sale, and 0 otherwise; and $\varepsilon_{i,t,t-n}$ is the regression error term. The data to estimate (2) come from the Florida Department of Revenue (DOR), who require that each county annually send to DOR an abbreviated version of its tax roll for auditing

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[20] Five of our employment centers were identified by Muller (1991), who is an urban geographer at the University of Miami. After consulting with him and checking secondary data sources we updated the list to include three additional centers.

[21] Interaction terms were also included to account for the possibility that the marginal value of living area depends on the number of rooms, and that the marginal value of lot size depends on the square footage of the house. See Rasmussen and Zuehlke (1988 and 1990).

[22] For sales occurring from 1985 through 1995, 1990 Census information is used, and for sales after 1995 information from the 2000 Census is used. Because income data from the 2000 Census for block groups had not been released at the time we estimated our models, we used 1990 median income for all years.

[23] Equation (1) assumes that the implicit prices on the variables entering the hedonic model are stable over time. As an alternative to (1), we estimated separate regressions for each year that included monthly dummy variables in order to allow implicit prices to change from one year to the next. Because the price index obtained from these regressions is highly similar to our original index (correlation = .93) and both indexes yielded similar results in stage two, we only report the results obtained using our original index. Gatzlaff and Ling (1994) also find that it makes little difference in the construction of price indexes from hedonic models whether or not implicit prices are allowed to vary over time.

[24] Only "arms length" sales are used and a number of filters are used to delete incomplete and incompatible observations (e.g., homes selling for $1). These filters are based on Gatzlaff and Ling (1994), who also used county appraisers data for Dade County, Florida. These criteria were also used in the repeat-sales models.

[25] These first stage results are available by request from the authors.

purposes. The file that DOR receives contains the two most recent sale prices of each property and the year and month of each of these sales. This is all the information required to estimate (2).

A criticism of repeat-sales models is that improvements to existing homes and vacant land are not taken into account. This can cause repeat-sales indices to overstate the true amount of house or land price inflation. However, as long as possible overestimates in month-to-month inflation are not systematically related to changes in impact fees, they should have little effect on our results.

Another criticism of repeat-sales models is that repeat sales may not be representative of the stock of housing or residential lots. To address this concern we obtained from DOR all of the tax files sent to them by Dade County that DOR still had available (1994-2000). All properties that experienced a second sale over these seven years are included in our samples as long as the first sale occurred after 1989. Two separate indexes are obtained from the estimation of repeat-sales models: one for existing housing (RS_Ex) and one for vacant residential land (RS_Land).[26,27] The results from estimating the repeat-sales models show that RS_Ex and RS_Land are based on 25,000 and 1,000 repeat sales, respectively. The R^2s for these two models are .48 and .36, which are comparable to those obtained for similar repeat-sales models estimated in the literature (Goodman and Thibodeau, 1998; McMillen and Dombrow, 2001; Macpherson and Sirmans, 2001).

Second Stage

Because the impact fees we study are imposed by Dade County and this county forms the boundaries of the Miami metropolitan area housing market, in stage two we estimate a model that is designed to explain changes in metropolitan housing prices over time. The standard model used for this purpose takes a stock-flow approach, which assumes that house prices in a particular period are determined by current values of the model's other variables, while the stock of housing depends on the historical values of these variables. Following DiPasquale and Wheaton (1994; 1996, Chapter 10), we assume that the current demand for owner-occupied housing, D_t, is proportional to the number of current households, H_t.[28] This proportion, which determines the homeownership rate, is assumed to depend in a linear fashion on the price of housing, P_t; the annual cost of purchasing \$1 of housing, U_t; the price of renting, R_t; and the average income per household, Y_t. U is the owner cost of capital and is equal to:

$$U = \left(i + t_p\right)\left(1 - t_y\right) - E\left(\frac{\Delta P}{P}\right), \tag{3}$$

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[26] The alternative to estimating (2) for vacant land would be to estimate a hedonic price model analogous to those estimated for new and existing housing using the 2001 tax roll. However, this would identify only those properties that are vacant as of January 1, 2001. The most recent sale of many of these properties occurred many years ago. The use of this sample would therefore over-represent vacant residential parcels that are being held and not developed, which may result in selection bias.

[27] In the RS models the first quarter of 1990 served as the benchmark period for which T=0. Hence, the index begins in April 1990 and runs through December 2000.

[28] It may appear that D being proportional to H violates the assumption of a horizontal housing demand curve, but changes in H will still cause vertical shifts in demand that will affect price.

where i is the mortgage rate, t_p is the effective property tax rate, t_y is the marginal income tax rate, and $E(\Delta P/P)$ is the expected rate of future housing price appreciation. The variables t_p and t_y are more precisely defined as the average rates expected by the household over the expected duration of stay in the home. According to the new view theory of impact fee incidence, impact fees lower expected future property tax rates. Hence, t_p is functionally related to impact fees.

Based on the above, the demand for single-family housing units, D_t, can be expressed as:

$$D_t = H_t(\alpha_0 - \alpha_1 U_t - \alpha_2 P_t + \alpha_3 R_t + \alpha_4 Y_t). \tag{4}$$

In equilibrium $D_t = S_t$, where S_t is the stock of housing. Solving for the price that clears the market $\left(P_t^*\right)$ results in this price depending on demand determinants and the ratio of stock to households:

$$P_t^* = \frac{1}{\alpha_2}\left[\frac{S_t}{H_t} - \alpha_1 U_t + \alpha_3 R_t + \alpha_4 Y_t\right] \tag{5}$$

The dependent variables used to estimate (5) are the new house price and existing house price indexes constructed in the first stage. All independent variables are described below as well as in Table 2, which also provides the mean and standard deviation for each variable.

To construct the housing stock series we begin with the 1980 Census count of the total number of detached single-family units as of April 1980. This number is updated monthly by adding to it the number of completions.[29] For April 1990 we compared the calculated series with the new Census count and then repeated this process for 1990-2000. In order to correct for demolitions and abandonment, removal rates were applied so that the calculated stock series would meet the Census benchmarks each decade. To construct the slack variable (S_t/H_t), we also needed a monthly series of the number of households. Using census information on household size, we first fit a cubic spline to interpolate household size for each month between census years. Then, monthly population estimates were divided by these household size estimates to obtain an estimate of the number of households.[30]

Because we have no data on the marginal income tax rates of Dade County residents and we are interested in separately estimating the price effect of impact fees, in lieu of including U in our estimated models we separately include its component variables: the 30-year conventional mortgage rate from the Federal Home Loan Mortgage Corporation;

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[29] The number of completions per month is based upon monthly project and permit data obtained from F.W. Dodge, Inc. Completions are estimated from these data by referring to Census estimates of the length of construction time based on the type of project and the dollar size of the project.

[30] To obtain monthly population estimates we fit a cubic spline to annual data from *Florida Estimates of Population* (published by the Population Studies Group in the Bureau of Economic and Business Research (BEBR) at the University of Florida), and subtracted group quarters (data from BEBR). BEBR produces its population estimates using the housing unit method. This method, which is the most commonly used method for making local population estimates in the United States, has a proven track record for producing reasonably accurate population estimates. It involves using a wide variety of data sources to calculate the number of occupied housing units which is then multiplied by the average number of persons per household.

the expected average property tax millage rate, and the expected rate of house price appreciation. The average millage rate expected by households over the expected duration of stay in the dwelling unit is measured by including both the current millage rate and the level of impact fees.[31] To measure expected appreciation we assume that price appreciation over the past year is used by consumers to determine future price growth.[32]

R_t is measured as the housing rent component of the Miami CPI, which is available on a monthly basis. To construct a monthly per capita income variable, we first obtained annual per capita income for Dade County from the U.S. Bureau of Economic Analysis (BEA) for the years 1984-2000. Monthly estimates were then interpolated using a cubic spline.[33]

An important advantage of our second stage models is that impact fees are included as a continuous variable that displayed considerable variation over the years covered by our study. The first fee adopted by Dade County was a road fee that was introduced in June 1989. Fire and police fees were added in April 1990 and park fees in July 1990. Revisions were made to the impact fee ordinances in October 1994 in response to fee amounts deemed too small to fund infrastructure construction, and the road, police, fire, and park fees all increased. The school fee started in October 1995, and currently represents about half the total fees facing a typical home. For the new home with the mean amount of square feet of living area (2072), total fees grew in nominal value from $879 in June 1989 to $5,239 in December 2000 (see table 3).[34]

The advantage of using a continuous fee variable that varies over a long period of time is that the variable is less likely to be correlated with unmeasured time-related events that themselves may affect housing prices. As discussed in Section III, early studies of the incidence of impact fees relied upon a single discrete change in fees to estimate their price effects. Both studies estimated implausibly large fee effects which Yinger (1998b) suggested might be explained by a coincident shock to the housing market that was omitted from the models.

In addition to estimating housing price models based on (5), we estimate reduced form models for the price of vacant residential land. The value of undeveloped residential land is derived from the profitability of new housing construction. The latter will depend on P_t and the costs of development. We therefore estimated land price models that include the price-determining variables included in (2) and, in addition to impact fees, two measures

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[31] The property tax millage rate is a weighted jurisdictional ad valorem rate, where the weight is the percent of total county population residing within the jurisdiction.

[32] Using an average of price appreciation over the previous two years, as suggested by DiPasquale and Wheaton (1996), yielded similar results.

[33] Because BEA's annual per capita income estimate for 2001 (reported for June) was not available at the time we estimated our models, per capita income was predicted for each of the last six months of 2000 based upon a regression of monthly per capita income on monthly per capita sales tax collections for Dade County. Sales taxes explained about 90 percent of the variation in income.

[34] All of the fees are per unit fees except the school fee, which has a per unit component and square footage component.

of development costs—the short-term interest rate and Means Building Construction Cost Index.[35]

In both the housing and land price models there are two final estimation issues. First, we need to account for changes in the overall price level. To accomplish this, rent, per capita income, the short-term interest rate, construction costs, impact fees, and the housing and land price indices are all adjusted for inflation using the monthly CPI for Miami.[36] Second, the length of the time period associated with real estate transactions must be recognized. Sales are reported as of the time of closing while purchase agreements are signed generally between 45 and 60 days prior to that date. To account for this time interval, all variables are lagged 2 months, with the exception of impact fees and the millage rate. The reason for not lagging impact fees is that there is a lag between their announcement and their effective date. Hence, market participants should know what fees will apply at the time of closing. The millage rate is the previous year's rate because in Florida the current year millage rate is announced toward the end of the year.

Results

The results for all estimated models are reported in Table 4.[37] Based upon Durbin-Watson tests for AR(1) serial correlation, the null hypothesis (H_o: $\rho = 0$) is rejected in favor of the alternative hypothesis (H_1: $\rho > 0$) for the models that use the existing home hedonic price index (H_Ex) and the existing home repeat-sales index (RS_Ex) as dependent variables. To account for serial correlation, Prais-Winsten models are estimated. For the models that use the new home hedonic price index (H_New) and the vacant residential land repeat-sales price index (RS_Land) as dependent variables the null hypothesis could not be rejected; thus, for these models OLS results are reported. Based upon the results obtained with Breusch-Pagan tests, heteroskedasticity-robust standard errors are reported for all models.

The estimated coefficient on the impact fee variable in the H_New equation (column 1) is 1.64 and it is statistically significant at the one percent level.[38] In the H_Ex equation, the estimated coefficient on impact fees is 1.68, which is significant at the five-percent level. These estimated fee effects (1.64 versus 1.68) are not significantly different from one

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[35] For the short-term rate, we use the prime loan rate. The construction cost index is the R.S. Means Building Construction Cost Index, adjusted for time and using the Miami city index.

[36] Following DiPasquale and Wheaton, the owner cost of capital variables (long-term interest rate, the property tax rate, and the expected house price appreciation rate) remain in nominal values, because the owner cost of capital measures the annual cost of purchasing one dollar of housing.

[37] The hedonic models have 178 observations (starting March 1, 1986) since the price appreciation variable is constructed using price index changes over the past year and is then lagged two months. The RS_Ex model has 115 observations (starting June 1, 1991) since the index starts in April 1990 and the price appreciation variable is constructed using RS_Ex index changes over the past year and is lagged two months. The RS_Land model has more observations (128) than the RS_Ex model since the price appreciation variable is constructed using changes in the H_New index which begins in 1986, and thus a year's worth of data is not lost in the construction of the price appreciation variable as it is in RS_Ex.

[38] Because we have a clear sign hypothesis on impact fees in the housing models, one-tailed tests of significance are employed. For the land model the expected sign is ambiguous and therefore a two-tailed test of significance is employed.

another and neither coefficient is significantly different from one (probability values equal to 0.18 and 0.49, respectively).

Column 3 of Table 4 reports the results from estimating the RS_Ex model. The estimated coefficient on impact fees is .0000167, which is significant at the five percent level. Because the average real price of existing homes in our sample is roughly $100,000, this coefficient estimate implies that an additional dollar of real impact fees increases the real price of the average existing home by $1.67, which nearly matches the $1.68 result obtained from the H_Ex model.

The estimated price effects of impact fees reported above are consistent with the new view but not the old view theory of impact fee incidence. The new view predicts that impact fees should have uniform effects on new and existing housing and allows for the fee-induced increase in the price of housing to exceed the amount of the fee. According to the old view, impact fees should increase the price of new housing by more than that of existing housing and the former increase should be less than the amount of the fee.

Further support for the new view is provided by relating the estimated price effects to the property tax savings caused by the use of impact fees. The magnitudes of the estimated fee effects indicate that housing prices rise by about $1.60 for each additional dollar of impact fees. This affect might seem large, but recall that Dade County experienced rapid in-migration during the study period, and thus the expected property tax savings were quite large as the proportion of new residents was relatively high. According to the new view, the effect that fees have on housing prices should reflect the property tax savings that homeowners expect to realize from shifting the costs of new infrastructure away from themselves to developers. To roughly gauge whether our estimated fee effects are consistent with expected tax savings we created a data set that contained for the years 1985-2000 the ad valorem millage rate (M) measured in dollars per $1,000 of assessed value, real impact fees (F, measured at the beginning of each year), and a linear time trend (T, 1 to 16). A regression of the millage rate on real fees lagged 1, 2, and 3 years and on T produced the following results (standard errors in parentheses):

$$M_t = 23.6 - .00005F_{t-1} - .0003F_{t-2} - .00108F_{t-3} + .368T$$
$$(1.38) \ (.0004) \qquad (.0004) \qquad (.0004) \qquad (.252) \qquad R^2 = .58$$

These results show that impact fees do reduce the millage rate but the effect obtains statistical significance only after a three year lag.[39] The above estimated reduction of .0011 in the millage rate from a $1.00 increase in fees results in a present value of property tax savings of about $1.20 for the mean priced house in our sample.[40] While the actual property tax savings expected by homeowners from the imposition of fees cannot be measured, the results from the above regression indicate that our estimated fee effects

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[39] The lagged effect of F on M can be attributed to the fact that in the first year or so after the fee has been imposed or increased many of the new homes sold were permitted before the change in fees became effective. Fees in Dade County are paid at the time the permit is issued.

[40] These calculations assumed a discount rate of 5 percent and took into consideration Florida's $25,000 homestead exemption, the fact that assessed value equals 85 percent of market value, and the finding that the tax savings are delayed.

on housing prices are roughly in line with the tax savings that were experienced by homeowners.

It might be questioned that homebuyers are capable of making the link between the imposition of impact fees and lower property tax payments in the future. It may also seem implausible that the expected savings in property taxes raise the bids of housing consumers, resulting in the capitalization of these savings into property values. However, it is important to remember that what matters for property value determination are not the capabilities of most people but only those of the marginal bidder. Also, the capitalization suggested by our results is consistent with an extensive empirical literature that finds that local public interventions and amenities are capitalized into land markets.[41]

Among the control variables that enter the housing models, the slack variable (housing stock divided by the number of households) and real per capita income are statistically significant in all models with the correct signs. The effects of the remaining control variables vary across models, but in general these variables add little to the explanatory power of the models.[42]

The results from estimating the vacant land models are presented in the final column of Table 4. Impact fees are found to reduce land values and the effect is statistically significant at the five percent level. The Dade County Property Appraiser 2001 tax roll that we used to estimate the H_New and H_Ex price indexes reports both assessed total property value and assessed land value for each single-family home. The mean ratio of the latter to the former is .20. Hence, given a real home price of $100,000, the implied value of the land is $20,000. The estimated coefficient on impact fees in the RS_Land model (-.000047) when multiplied by the average real value of impact fees ($1675) implies a reduction in land value of roughly 8 percent, which equals $1600 if the lot price originally equaled $20,000. These calculations suggest that land values fall by roughly the value of impact fees.

Based upon our housing model results, developers of new housing appear to be fully compensated for the impact fees that they pay by increases in the prices that they can charge for new homes. (Recall that the estimated effect of an additional dollar of real impact fees on the price of new housing is not significantly different from one.) Hence, there would seem to be no reason for fees to be shifted backward to landowners. However, developers' bids for land are based upon the profits they expect to earn sometime in the future when their new homes are offered to the market. Considerable time may pass between the purchase of the land and the payment of impact fees. As is generally the case, in Florida impact fees are assessed at the time building permits are

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[41] Recent examples of such capitalization can be found in many of the papers presented at the July 2002 Lincoln Institute of Land Policy Conference *Analysis of Urban Land Markets and the Impact of Land Market Regulation*, where our paper was first presented. See, in particular, the papers by Gibbons (2002), Shoup (2002), Irwin and Bockstael (2002), and Cheshire and Sheppard (2002).

[42] The weak performance of the housing rent index and the millage rate as control variables is not surprising given the limited variation in these variables over the years covered by our data. The coefficient of variation of the rent index is 2 while that of the millage rate is 4. In contrast, the coefficient of variation of impact fees is 78.

issued. Local land use regulations often add long delays to the development process. For example, before building permits can be issued, subdivision permits must be obtained, rezoning of existing parcels from agricultural use may be necessary, and environmental impact statements must be filed. Given the steady increase in impact fees within Dade County since their inception, developers may expect that because of these regulatory delays, as well as the significant time involved in housing construction apart from any bureaucratic delays, the fees that will affect them will be higher than those currently in place. There may also be considerable uncertainty over the impact these higher fees may have on housing prices. Our findings suggest that developers' uncertainty over impact fees cause them to lower the price they are willing to pay for land.

Among the control variables that enter the RS_Land model, only the slack variable is statistically significant (at the five percent level). That this is the only house price determinant that matters to land value is not surprising, given the general insignificance of the other variables in the housing price models.

Conclusion

The three principal predictions of the new view theory of impact fee incidence are that 1) impact fees increase the prices of new and existing homes by the same amount, 2) the increase in the price of housing equals the present value of the property tax savings expected by homeowners from the shift from property tax finance to the use of impact fees to pay for new public capital services, and 3) undeveloped land values decline if the increase in the price of housing is insufficient to guarantee developers of new housing a competitive rate of return. The results presented in this paper for Dade County, Florida are consistent with these predictions. First, we find that the difference in the effect of an additional dollar of real impact fees between new and existing housing is small and statistically insignificant. Second, although we are unable to measure the property tax savings that are expected by homeowners from the imposition of fees, we do find that higher fees reduce millage rates and the present value of the associated property tax savings are in line with the estimated effects of fees on housing prices. Finally, impact fees are found to reduce land values. While the increase in housing prices is found to cover the current level of fees, developers purchasing land in the present have no assurance that rising housing prices will cover future fees, especially given the unpredictable upward trend in total fees over time. Hence, impact fees that are arbitrarily imposed or increased add additional uncertainty to the development process, causing developers to reduce the amount they are willing to pay for land.

At the outset of this paper we motivated our analysis of the incidence of impact fees by noting that they have been both criticized and praised in recent policy discussions. They have been criticized for reducing the affordability of homeownership. It is frequently argued that since most fees are flat amounts levied on a per unit basis, they cause larger percentage increases in the prices of starter homes than more expensive homes. However, this conclusion is based on the old view prediction that impact fees are partially borne by buyers of new homes. Under the new view, impact fees are not shifted forward to new homebuyers. Since our results are consistent with only the new view theory, they provide no support for the argument that impact fees reduce homeownership affordability.

Impact fees have also been praised as an effective anti-sprawl policy. Our results suggest that the rate at which agricultural land is converted to residential use is slowed by impact fees. By reducing the price of vacant residential land, impact fees lower the opportunity cost of continuing to use land for agricultural purposes, causing land to be held for a longer period in agricultural use. Some support can therefore be found in our results for the idea that at least the rate of suburban sprawl is slowed by impact fees.

In other settings, impact fees may have quite different consequences than those reported here. Everything depends on the savings homeowners expect in property taxes, which will depend on the mix of new and original residents. In places that are not growing as fast as Miami, the savings in property taxes by the individual homeowner will be smaller, resulting in the possibility that fees will increase housing prices by less and reduce land values by more than we observed for Dade County, Florida. It is, therefore, important to empirically investigate the price effects of impact fees for other areas to verify the support found here for the new view theory of fee incidence.

Bibliography

Altshuler, Alan A. and Jose A. Gómez-Ibáñez.1993. *Regulation for Revenue: The Political Economy of Land Use Exactions*. Washington, D.C.: The Brookings Institution.

Baden, Brett M. and Don L. Coursey. 2002. "An Examination of the Effects of Impact Fees on Chicago Suburbs" unpublished version of *Harris School working paper 99.20*, revised in January 2002, Harris Graduate School of Public Policy Studies at the University of Chicago.

Bousquet, Steve. 1999. "Plan to cut fees could affect schools." *The Miami Herald*, March 22, 4B.

Charles, Jacqueline. 2000. "School impact fees might be replaced." *The Miami Herald*, April 17, 3B.

Cheshire, Paul and Stephen Sheppard. 2002. "Capitalization of Free Schools: Which Schools Do We Pay For?" Presented at the Lincoln Institute of Land Policy Conference *Analysis of Urban Land Markets and the Impact of Market Regulation*. July 10-12.

Cobb, Steven A. 1984. "The Impact of Site Characteristics on Housing Cost Estimates." *Journal of Urban Economics* 15, no. 1 (January): 26-45.

Delaney, Charles J. and Marc T. Smith. 1989a. "Impact Fees and the Price of New Housing: An Empirical Study." *American Real Estate and Urban Economics Association Journal* 17: 41-54.

--------. 1989b. "Pricing Implications of Development Exactions on Existing Housing Stock." *Growth and Change* 20: 1-12.

Deyak, Timothy A. and V. Kerry Smith. 1974. "Residential Property Values and Air Pollution: Some New Evidence." *Quarterly Review of Economics and Business* 14, no. 4 (Winter): 93-100.

DiPasquale, Denise and William C. Wheaton. 1994. "Housing Market Dynamics and the Future of Housing Prices." *Journal of Urban Economics* 35: 1-27.

--------. 1996. *Urban Economics and Real Estate Markets*. Englewood Cliffs, NJ: Prentice Hall.

Downing, Paul B. and Thomas S. McCaleb. 1987. "The Economics of Development Exactions," in *Development Exactions*, James E. Frank and Robert M. Rhodes, ed., 42-69. Washington, DC.: Planners Press.

Dresch, Marla and Steven M. Sheffrin. 1997. *Who Pays for Development Fees and Exactions*. San Francisco, CA: Public Policy Institute of California.

Gatzlaff, Dean H. and David C. Ling. 1994. "Measuring Changes in Local House Prices: An Empirical Investigation of Alternative Methodologies." *Journal of Urban Economics* 35: 221-244.

Gibbons, Steve. 2002. "Evaluating the Costs of Urban Crime." Presented at the Lincoln Institute of Land Policy Conference *Analysis of Urban Land Markets and the Impact of Market Regulation*. July 10-12.

Goodman, Allen C. and Thomas G. Thibodeau. 1998. "Dwelling Age Heteroskedasticity in Repeat Sales House Price Equations." *Real Estate Economics* 26: 151-171.

Huffman, Forrest E., Arthur C. Nelson, Marc T. Smith, and Michael A. Stegman. 1988. "Who Bears the Burden of Development Impact Fees?" *Journal of the American Planning Association* 54: 49-55.

Irwin, Elena and Bockstael. 2002. "Urban Sprawl as a Spatial Economic Process." Presented at the Lincoln Institute of Land Policy Conference *Analysis of Urban Land Markets and the Impact of Market Regulation*. July 10-12.

Linneman, Peter. 1980. "Some Empirical Results on the Nature of the Hedonic Price Function for the Urban Housing Market." *Journal of Urban Economics* 8:47-68.

--------. 1981. "The Demand for Residence Site Characteristics." *Journal of Urban Economics* 9:129-148.

--------. 1982. "Hedonic Prices and Residential Location," chapter 3 in Douglas Diamond and George S. Tolley, ed., *The Economics of Urban Amenities*. Academic Press: 69-88.

Macpherson, David A. and G. Stacy Sirmans. 2001. "Neighborhood Diversity and House-Price Appreciation." *Journal of Real Estate Finance and Economics* 22: 81-97.

McMillen, Daniel P. and Jonathan Dombrow. 2001. "A Flexible Fourier Approach to Repeat Sale Price Indexes." *Real Estate Economics* 29: 207-225.

Muller, Peter O. 1991. "The Urban Geography of South Florida," chapter 5 in Thomas D. Boswell, ed., *South Florida: The Winds of Change.* Coral Gables, FL: University of Miami, Department of Geography: 62-69.

Nelson, Arthur C., Jane H. Lillydahl, James E. Frank, and James C. Nicholas. 1992. "Price Effects of Road and Other Impact Fees on Urban Land." *Transportation Research Record* 1305: 36-41.

Palmquist, Raymond B. 1991. "Hedonic Methods," chapter 4 in John Braden and Charles Kolstad, ed., *Measuring the Demand for Environmental Quality*. Elsevier Science Publishers B. V. (North-Holland): 77-120.

--------. 2000. "Property Value Models." Department of Economics, North Carolina State University.

Rasmussen, David W. and Thomas W. Zuehlke. 1988. "The Evaluation of Residential Living Space." *Review of Regional Studies* 18: 47-53.

--------. 1990. "On the Choice of Functional Form for Hedonic Price Functions." *Applied Economics* 22: 431-438.

Shoup, Donald. 2002. "Curb Parking: The Ideal Source of Public Revenue." Presented at the Lincoln Institute of Land Policy Conference *Analysis of Urban Land Markets and the Impact of Market Regulation*. July 10-12.

Singell, Larry D. and Jane H. Lillydahl. 1990. "An Empirical Examination of the Effect of Impact Fees on the Housing Market." *Land Economics* 66: 82-92.

Skaburskis, Anrejs and Mohammad Qadeer. 1992. "An Empirical Estimation of the Price Effects of Development Impact Fees." *Urban Studies* 5: 653-667.

Smith, V. Kerry and Timothy A. Deyak. 1975. "Measuring the Impact of Air Pollution on Property Values." *Journal of Regional Science* 15, no. 3 (December) :277-288.

Snyder, Thomas P., Michael A. Stegman, and David H. Moreau. 1986. *Paying for Growth: Using Development Fees to Finance Infrastructure*. Washington, D.C.: Urban Land Institute.

Yinger, John. 1998a. "Who Pays Development Fees?" In *Local Government Tax and Land Use Policies in the United States: Understanding the Links*, Northampton, Mass: Edward Elgar.

--------. 1998b. "The Incidence of Development Fees and Special Assessments." *National Tax Journal* 51: 23-41.

--------, Howard S. Bloom, Axel Boersch-Supan, and Helen F. Ladd. 1988. *Property Taxes and House Values: The Theory and Estimation of Intrajurisdictional Property Tax Capitalization*. New York: Academic Press.

Table 1

Previous Literature on Effects of Impact Fees on House and Land Prices

Article	Sample	Impact Fee Effects
Delaney & Smith (1989a)	Dunedin, FL	$\dfrac{\partial P_{New}}{\partial Fee} > 3 \times Fee$
Delaney & Smith (1989b)	Dunedin & Clearwater, FL	$\dfrac{\partial P_{New}}{\partial PFee} > 2 \times \dfrac{\partial P_{Exs}}{\partial P_{Fee}} > Fee$
Singell & Lillydahl (1990)	Loveland, CO	$\dfrac{\partial P_{New}}{\partial Fee} > 3 \times Fee, \dfrac{\partial P_{Exs}}{\partial Fee} > 6 \times Fee$
Nelson, et al. (1992)	Loveland, CO	$\dfrac{\partial P_{Land}}{\partial Fee}$ insignif
	Sarasota Co., FL	$\dfrac{\partial P_{Land}}{\partial Fee} > 0$
Skaburskis & Qadeer (1992)	Toronto	$\dfrac{\partial P_{Land}}{\partial Fee} = 1.2 \times Fee$
Dresch & Sheffrin (1997)	W. Contra Costa Co., CA	$\dfrac{\partial P_{New}}{\partial Fee} = 1.88 \times Fee, \dfrac{\partial P_{Exs}}{\partial Fee}$ insignif
	E. Contra Costa Co., CA	$\dfrac{\partial P_{New}}{\partial Fee} = .25 \times Fee, \dfrac{\partial P_{Exs}}{\partial Fee} = .23 \times Fee$
Baden & Coursey (2002)	Chicago	$\dfrac{\partial P_{New \& Exs}}{\partial Fee} \approx Fee$

Table 2

Means, Standard Deviations, and Descriptions for Selected Variables

Variable[a]	Mean (Stan. Dev.)	Description	Source
construction cost index[b]	0.6603598 (0.0415263)	(National index) x (City index /100)	R.S. Means
short-term interest rate	5.277133 (1.37439)	Prime loan rate	Federal Reserve
slack, S/H	0.5409327 (0.012593)	Housing stock as a percentage of households	BEBR, University of Florida
rent	94.47952 (1.967138)	Rent of primary residence	CPI, Miami-Ft. Lauderdale
per capita income	14,352.74 (509.3557)	Annual per capita personal income	U. S. Bureau of Economic Analysis
long-term interest rate	8.933387 (1.54706)	30 year average mortgage contract rate	Federal Home Loan Mortgage Corporation
millage rate	0.0251466 (0.0010776)	Population-weighted county millage rate	Dade County Property Appraiser
expected house price appreciation: E(Exs Hedonic)	0.0601302 (0.0647184)	Percent change in price index over the previous year	1st stage models
expected house price appreciation: E(New Hedonic)	0.0448383 (0.062301)		
expected house price appreciation: E(RS90-Ex)	0.0455038 (0.0525498)	Difference in the price index over the previous year	
total impact fees-new[c]	1674.791 (1305.272)	Sum of fees for road, fire, police, parks, and schools	Dade County Planning and Zoning Dept.
total impact fees-exs	1643.944 (1267.35)		

[a] All variables are in real terms except the long-term interest rate, the millage rate, and the price appreciation variables, which are nominal.
[b] All variables are lagged two months except for total impact fees, which is current, and the millage rate, which is lagged one year.
[c] In calculating the total impact fees, two variables are created. Dade county school impact fees depend on square footage of the house, so we used mean square footage for new (2072) and existing (1908). We then applied the total fees using the average existing home to the existing models, and the total fees using the average new home to the new and land models.

Table 3

Nominal Impact Fee Totals for Dade County

Dates	Total Fees[a]
January 1985 – May 1989	$0
June 1989 – March 1990	$879
April 1990 – June 1990	$1141
July 1990 – June 1991	$1657
July 1991 – December 1992	$2174
January 1993 – September 1994	$2690
October 1994 – February 1995	$2330
March 1995 – September 1995	$2725
October 1995 – December 2000	$5239

[a] Fees are based on a new single-family home of average size (2072 square feet).

Table 4

Regression Results on House and Land Price Indices[a]

	Hedonic Models		Repeat Sales Models	
	H_New	H_Ex	RS_Ex	RS_Land
slack, S/H[b]	-227445.7***	-378891***	-2.779797***	-7.633373**
	(39661.34)[c]	(92231.01)	(.9700136)	(3.29907)
rent index	3.045224	-127.9393	-0.0012778	0.0108138
	(159.9745)	(252.111)	(0.0084769)	(0.010054)
per capita income	3.671029***	4.938763***	0.0000148**	0.0000228
	(0.7314755)	(1.471168)	(8.59e-06)	(0.0000325)
long-term interest rate	1173.712***	141.0492	0.0058517	0.0111474
	(355.5903)	(764.0517)	(0.0080215)	(0.0185877)
millage rate	559360.5	1878455**	-39.90678**	9.245199
	(525459.3)	(1011416)	(21.40147)	(43.05875)
expected house price appreciation	4004.218	-6094.796	0.0546225	0.0431968
	(5983.196)	(4626.109)	(0.1328163)	(0.1674872)
construction cost index				2.634197
				(2.52837)
short-term interest rate				-0.0230376
				(0.0165988)
total impact fees	1.640752***	1.680903**	0.0000167**	-0.0000466**
	(0.4724002)	(0.981412)	(8.23e-06)	(0.0000236)
constant	138630.2***	177732.9***	2.351436***	1.035336
	(29529.56)	(68427.75)	(0.7016796)	(1.493693)
R^2	0.6730	0.5719	0.3422	0.1849
N	178	178	115	128

* significant in one-tailed test at 10% (two-tailed test for RS_Land)
** significant in one-tailed test at 5% (two-tailed test for RS_Land)
*** significant in one-tailed test at 1% (two-tailed test for RS_Land)

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[a] The H_New and RS_Land models are OLS regressions, and the H_Ex and RS_Ex models are Prais-Winsten (AR1) regressions (rho = .716 and .798, respectively).
[b] All variables are lagged two months except for total impact fees, which is current, and the millage rate, which is lagged one year.
[c] Robust standard errors in parentheses.