Impact Fees and New Housing Cost: A comparative analysis of the empirical models

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Abstract: Developers and policy makers are consistently at odds over the debate as to whether impact fees increase house prices. This debate continues despite the extensive body of theoretical and empirical international literature that discusses the passing on to home buyers of impact fees, and the corresponding increase to housing prices. In attempting to quantify this impact, over a dozen empirical studies have been carried out in the US and Canada since the 1980's. However the methodologies used vary greatly, as do the results. Despite similar infrastructure funding policies in numerous developed countries, no such empirical works exist outside of the US/Canada.

The purpose of this research is to analyse the existing econometric models in order to identify, compare and contrast the theoretical bases, methodologies, key assumptions and findings of each. This research will assist in identifying if further model development is required and/or whether any of these models have external validity and are readily transferable outside of the US. The findings conclude that there is very little explicit rationale behind the various model selections and that significant model deficiencies appear still to exist.

Keywords: Impact fees, infrastructure charges, housing affordability, econometric models.

1. INTRODUCTION

The provision of new urban infrastructure in growing communities has been a policy dilemma for governments around the world for decades. On one hand, governments may appease existing residents by shifting the responsibility of funding new growth related infrastructure from the government to the development industry (Burge, 2008) ; however on the other hand, the passing-on of these costs to new homeowners is said to directly contribute to reduced housing affordability (Been, 2005). Data from empirical studies is required to ensure evidence based policy can be formulated.

1.1. Impact Fees

In the United States of America ("US"), growth related infrastructure cost recovery policies in the form of fees charged to developers have been in place since the 1970's (Been, 2005). Known as "impact fees", these charges are largely intended to encompass the estimated proportionate cost of providing trunk and other off site urban infrastructure such as local roads, stormwater and community facilities/parks to new development. It is a one off charge levied on the residential developer, generally at the time of rezoning/approval (Ihlanfeldt and Shaughnessy, 2004, Campbell, 2004, Burge, 2008, Been, 2005, Mathur et al., 2004)

Around the globe, other terminology is used to describe what are essentially similar urban infrastructure funding mechanisms. For example, the term "Development Charges" is prominent in Canada, "Planning obligation", "planning gain" or "Section 106 agreements" are all terms used to describe the equivalent to an infrastructure charging system in the United Kingdom ("UK") (Evans, 2004). "Exactions" is a general term used in Indian (3iNetwork, 2009) and some American literature, whilst in Australia "Infrastructure Charges" or "Developer Contributions" are largely interchangeable terms depending on the jurisdiction (Chan, 2009).

The adverse effect such fees have on housing prices is well documented internationally from a theoretical perspective. However empirical studies which seek to quantify this impact on housing prices only exist in the US and Canada (Bryant and Eves, 2011) where fixed fees for infrastructure provision are charged to residential developers at a county level. This gap in the research may be due in part to the opaque fee structures in other countries. For example, in the UK Section 106 agreements are based solely on negotiation between developer and council, with no set fee structure from which to base calculations (Bailey, 2005). In Australia, there is little consistency or transparency across jurisdictions as to how infrastructure charges are applied (Productivity Commission, 2011).

1.2. Empirical Models

In excess of a dozen empirical studies have examined how much impact fees increase new house prices by in the US and Canada. The theoretical argument is well developed and consistent in its findings that impact fees do increase the price of new housing in strong markets in the short term, and that prices also increase in the longer term when weaker market conditions prevail (Been, 2005). Whilst the empirical evidence is not as consistent, a pattern has emerged over a number of recent US studies that indicates for every $1 increase in impact fees, new housing prices increase by $1.50 - $1.70 (Burge, 2008). Each model claims to have built on the methodological shortcomings of various predecessors. However the varying approaches and methodologies applied provide no guidance as to the most evolved model, or the external validity of any outside of the sample area. These issues form the basis of this research.

1.3. Purpose

The purpose of this paper is to analyse the various US empirical models that seek to measure the effect of impact fees on new housing prices. This research will identify, compare and contrast the theoretical bases, methodology and findings of each. This step is important in identifying the most evolved model as well as determining whether any of these models have external validity and are readily transferable outside of the US. This will be achieved through archival analysis of the various existing studies, focusing on the methodologies employed, specification of those

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models and key assumptions. To the best of the author's knowledge, research to incorporate all the above aspects has not been done before. Been (2005) does focus on the advances and drawbacks on theoretical grounds for housing price models. Her research goes only up until 2004, and does not involve assessment of econometric methods used. This work is the predecessor for further research into the impact of such infrastructure fees on new housing costs in the Australian market.

1.4. Structure

This introductory section sets the background for this topic. The following section details the relevant literature, whilst the third section outlines the methodology used for this research. The forth section presents the results, with the findings to follow, and the last section concludes.

2. LITERATURE

Theories on house and land pricing models have been pondered since Ricardo in 1817 (DiPasquale and Wheaton, 1996). Various models have since evolved based on the core assumption that housing is more expensive when it comprises more utility bearing attributes or characteristics, and that the sum of this bundle of attributes is reflected in the housing price. The marriage of the disciplines of urban economics and econometrics over the past three decades has lead to "a proliferation of empirical studies" that have progressively sought to predict and explain residential property values and the impacts of these various attributes on house prices (Limsombunchai et al., 2004). Cho (1996) claims this proliferation is due to the increased availability of multiple data sets, improvements in modeling techniques and software and the subsequent expansion in business applications.

Hedonic price models based on multiple regression theory have evolved since the seminal work of Griliches in 1971 and Rosen in 1974 (Meese and Wallace, 2003). These static models provide for differentiation of individual attributes whilst controlling for heterogeneous characteristics that are commonly thought to contribute to house price such as location, age, number of bedrooms and the like (Dougherty, 2011). These models are commonly a two stage process, with the first stage comprising the construction of a repeat sales house price index. This index is then introduced and the dependent variable in the second stage hedonic analysis (Meese and Wallace, 2003).

Whilst being a widely used and accepted method for accommodating housing heterogeneity and the separate price contribution of various attributes, such models must be specified and interpreted with caution (Malpezzi, 2002). Firstly, care must be taken to ensure any first stage estimation error is adjusted for when used in the second stage equation. Also, as a static model, the results do not account for any trend in average house prices over time (Meese and Wallace, 2003). Further, Shonkwiler and Reynolds (1986) purport that stringent assumptions on the preferences of market participants is necessary and Limsombunchai et al (2004) identify common hedonic modeling issues as: heteroskedasticity, model specification errors, mulitcollinearity, independent variable interactions, non-linearity and outlier data points. Cho (1996) also identifies autocorrelation and up to five types of bias that may jeopardise the correct interpretation of hedonic outputs.

A further challenge to the use of the hedonic technique is the multitude of functional forms that it can take. Messe and Wallace (2003) observe that specification of the model will depend on the type of data available. Limsombunchai et al (2004) conclude that economic theory provides no guidance with respect to this matter, and as a result each study may pursue its own form in an attempt to overcome the numerous potential errors identified above.

Despite its many apparent challenges, the conventional two-step static hedonic pricing model remains a relatively simple and popular estimation process.

Dynamic models differ from static methods by explicitly incorporating linkages in variables over time (DiPasquale and Wheaton, 1996). Similar to its static counterparts, methodological progressions exploded since the 1970's (Gujarati and Porter, 2009) with enhanced computational capacity. Contentious in that era, time series methods developed focusing only on movements in specific variables rather than large data sets, hence requiring significantly fewer data inputs than static models. Dougherty (2011) reports that this theoretical shift divided practitioners into two camps of static and dynamic methodologies, a differentiation that is evident in this research [2]. Whilst dynamic models assist in the understanding and forecasting of housing price trends over time, they bring with them a separate range of issues to be considered by the analyst such as: stationarity, multicollinearity and noncontemporaneous variables just to name a few (Gujarati and Porter, 2009).

The rationale behind various model selection is rarely explicit and may only have its roots in data type and availability (Meen, 2002). Time series, cross-sectional, pooled and/or panel data will lend themselves to varying theoretical bases and hence model specifications (Gujarati and Porter, 2010).

In summary, both static and dynamic modeling techniques have evolved in the past decades in an attempt to overcome measurement problems associated with housing's heterogeneous nature, the infrequency of trades and the negotiated pricing system as well as the nature and availability of data.

3. METHODOLOGY

Our approach to evaluating the recent empirical work carried out in search of evidence of impact fees' transferral to housing prices, is based on the following steps. Firstly, we identify main sources of research that are both frequently cited and credible in their chosen methodology. Secondly, the research is categorized for the type of modeling approach. The two main distinctions are whether the pricing models are static (hedonic) or dynamic (time series). Finally, the econometric models are evaluated for their appropriateness. This mainly focuses on the theoretical justification, as the data sets used in the original papers are not generally available. However, indications of model errors are also looked for.

These steps ensure the analysis is based on theoretically sound and qualitatively strong research and that the accomplishments are treated with respect to correct use of the econometric tools employed in any given paper. Such evaluation of the various methodologies employed and conclusions made should give an indication of the evolution of these models and whether any of these are potentially transferrable outside of the US.

4. FINDINGS

As previously stated, over a dozen empirical models utilising various econometric techniques have been published in the US since 1989 that attempt to quantify the effect of impact fees on new housing prices (Been, 2005) [3]. If we run with Burge's (2008) assumption that later econometric models correct for the methodological errors and in-appropriateness of data of the earlier

[2] Meen (2001) provides a survey of the literature on measurement errors associated with different house price index methodologies.

[3] For a full description of the studies that pre-date 2000, refer to Been (2005).

models, then for the purpose of this paper let us assess only those models carried out in the past decade.

Table 1: **Empirical Research Models and Findings 2000 – 2012**

Authors	Year	Methodology	Their Findings
Ihlanfeldt, Shaughnessy	2004	**Time-series** model using predictions from hedonic and repeat sales models, 32 jurisdictions with impact fees, over 16 years (monthly, 1985-2000), new and existing housing, vacant land.	Positive impact on new housing, no impact on existing housing or vacant land.
Burge, Ihlanfeldt	2006	**Time-series** model using predictions from repeat sales model, 41 counties with impact fees, over 11 years (1993-2003), new housing.	Weak evidence for positive impact of non-water/sewer fees on medium size houses.
Evans-Cowley, Forgey, Rutheford	2005	**Hedonic** pricing model; Cross-section, fixed effects panel, random effects panel of 43 cities with impact fees, 1999 data, developed lots and undeveloped land.	Positive impact on developed lot prices, no impact on undeveloped land.
Mathur, Waddell, Blanco	2004	**Hedonic** pricing model; Cross-section of 38 cities/towns with impact fees, over 10 years (1991-2000), new houses.	Positive impact in general, no impact on low quality houses, positive high quality housing.
Mathur	2008	**Hedonic** pricing model; Cross-section of 29 cities/towns with impact fees, over 10 years (1991-2000), new and existing houses.	Infrastructure improvements have generally positive impact on all housing. Services improvements have positive impact on existing housing; insignificant or negative impact on new housing.
Evans-Cowley, Lockwood, Rutherford, Springer	2009	**Hedonic** pricing model with treatment effects ; 38 cities with impact fees, 25 cities without impact fees, 1999 data, new and existing houses.	Positive impact on house prices, existing and new.

Source: Authors. Note: The term "positive" is used in the meaning of the impact fee transferring to the price in full or at a higher rate.

A total of six separate studies into the effect of impact fees on house prices in the US have been identified in the past decade. These six studies revolve around three main author groups: Ihlanfeldt (2004, 2006). Evans-Cowley and Rutherford (2005, 2009) and Mathur (2008, 2004).

Details of the various methodologies employed and findings of each study are summarised in Table 1. These models are categorised and analysed separately as static (hedonic) or dynamic (time series) approaches. A cursory glance will conclude that the methodologies used vary greatly, as do the results. This is perhaps typical of housing price models for which there are a variety of approaches and considerable diversity in both theory and outcomes (Meen, 2001). The complexity of housing price models, evidences itself in the studies above by the range of different theories adopted, variables utilised and their role as to how they explain or relate to housing price.

The remainder of this section is dedicated to exploring the key findings of each of these prior works, with a view to uncovering evidence of model evolution/maturity and transferability to other study areas.

4.1. Time Series

The two time series models are sourced from the Ihlanfeldt author group.

Ihlanfeldt and Shaughnessy (2004) use a panel of new and existing house prices across 32 jurisdictions over 15 years (monthly prices) in Florida. Their work claims to address the shortcomings of prior research including: outcomes inconsistent with economic theory, sparsely specified hedonic price models and omission of correlated variables. Their theory appears to be based on a market equilibrium model. Their modeling approach is done in two steps: In the first step, a time series of price indices are constructed. For new and existing houses, predictions from a static hedonic model in which dummy variables are used to account for both time and location, are used to construct a time series index. For existing houses and vacant land, a repeat sales model is used to form an index. In the second step, the indices are then used in a time series regression from which the marginal effects of impact fees are obtained. The models are somewhat unclearly presented and therefore it is not possible to directly judge their appropriateness. As the results are weak, there may be an issue with the model specifications or generation of the indices. Because the indices are constructed at sample averages, the overall results may be too general thereby resulting in insignificant effects. It is in effect time series because of the second step. The first step is static (hedonic) for new and existing housing, and time series for existing houses/vacant land.

Burge and Ihlanfeldt (2006) examine a panel of new houses in 41 counties over 11 years in Florida. Their theory is based on an extension of the standard urban model, whereby all development occurs on the urban edge, with the price of housing diminishing as the cost of commuting increases. Their contribution is to differentiate between water/sewer and non-water/sewer fees, using a completely different methodology to Ihlandfeldt and Shaunessy (2004). However, the employed models are simplistic, based on regressing a simple repeat sales model pricing index on the two impact fee variables. The reason for marginally significant results is difficult to determine because of the vague presentation of the models in this paper. There is also the possibility of sample selection bias due to a number of factors. The authors explicitly state they have excluded all counties without impact fees in order to identify the effects within-area fee variation. Also, the price index from repeat sales is not related to anything other than the timing of the sale. The time series model for prices does account for random effects and trends, and the two impact fee variables, but no other parameters

4.2. Hedonic

The remaining four hedonic models comprise two studies each from the Evans-Cowley and Rutherford author group and the Mathur author group.

Mathur, Waddell and Blanco (2004) use a panel of house prices across 38 cities/towns over 10 years. Their theory is implied at best, with little discussion dedicated to the study's basis. Earlier literature by the authors identifies omission of locational and quality variables. Their focus is on the sale of new housing of varying quality, with "quality" appearing to be categorised by housing size. The time dimension is accounted for with dummy variables, as is the jurisdiction, thus reducing their approach to the standard cross-sectional hedonic pricing model. They proceed to examining the whole data set, as well as splitting it into low and high quality housing, and find that the impact fees transfer is significant and higher to the high quality housing level. However, there are some econometric issues with the use of dummy variables. Furthermore, the model is in effect a fixed effect model and the conditions for appropriate use of such a model should be assessed to ensure reliable model estimation.. Hence their conclusions have to be taken with caution.

Marthur (2008) carries out a study in a similar set up as Mathur et al. (2004), and amending the data set to include existing housing sales as well. The theoretical basis remains unexamined, with reference made only to Rosen's 1974 hedonic analysis framework. There is little to no discussion provided on economic or housing price theory development. From the methodological point of view, the approach is unevolved from the previous study. The main difference is that of examining the effects of specific infrastructure and services on house prices at a housing sub-market level (high/low quality sub markets). Impact fees as defined in the earlier study are not included in the model, although are found to be significant. Therefore, from the model specification point of view, the results are suspected to suffer from bias. Another potential issue is that because the data includes existing housing, the same properties may enter the data set more than once, possibly invalidating the assumptions underlying the estimation theory.

Evans-Cowley, Forgey and Rutherford (2005) use a panel of lot and land values across 43 cities. They provide a useful discussion on the suitability of ordinary least square (OLS), fixed effects or random effects models for this type of analysis, concluding in the suitability of a generalized least squares approach. To estimate the hedonic pricing models for both developed lots and undeveloped land, they first use a cross-sectional model. The second model is a fixed effects panel, in which the city-invariant variables cannot be entered (due to collinearity with the city-specific intercepts) and their marginal effects therefore not assessed. The last model is a panel with random effects. Generally they find a positive impact of impact fees on developed lot prices, but fail to find a relation between undeveloped land and impact fees which is usually suspected to be a negative one. The location indicators (longitude and latitude) seem somewhat inappropriate as they are continuous variables, thereby bearing inherent order among them. By using a coordinate system, they assess values that can be meaningfully ordered (this is a continuous variable), when a priori we have no assumption of how the cities of Dallas, Fort Worth, Austin and Houston are ordered with respect to pricing of houses. An alternate approach could code them as dummy variables, and see if there are any differences between prices in these cities. In their present form, the authors assume that moving from north to south will change the house prices in the same linear fashion regardless of whether we move from Dallas to Austin or Dallas to Houston. Similarly, under the current specifications, moving from Houston to Dallas will have the same impact on house prices as moving from Dallas to Austin. Furthermore, there is a potential issue with the impact fee variable, because it seems to be directly derived from the lot or land size, a variable that enters the model both in linear and quadratic fashion. For the fixed effects model, a constant is reported but not defined. This is questionable as the impact fee could be highly collinear with lot size and squared lot size, because the fee is calculated as a basic fee times the number of half acre lots on a piece of land.

Evans-Cowley, Lockwood, Rutherford and Springer (2009) present perhaps the most evolved model, extending the standard hedonic pricing model in two ways. First, they include cities that have no impact fee system in place. Second, they introduce a latent choice variable, which is related to several variables presumed to affect the decision of a city to set up an impact fee. The theoretical basis for this evolution is implied at best. This so called two-step treatment-effect approach accounts for the endogeneity of the choice of a given city to impose impact fees, producing more reliable estimates of the impact fee effect. They find that the impact fees do transfer over to the sales price of both new and existing housing, with a ratio that is higher than one-to-one.

4.3. Overview

Impact fees can present themselves in several forms, and enter other variables indirectly. It is therefore crucial to take into careful consideration what is meant by the impact fee, or which type of impact fee the research is trying to find the effects of, and where its effect might appear. It is important to acknowledge the underlying process of deciding on whether or not to impose impact fees. This choice is influenced by endogenous information, and therefore an appropriate modeling approach to account for endogeneity is called for. Furthermore, a data set consisting solely of observations with impact fees in place is subject to sample selection bias. A control group is needed to avoid this problem, as is introduced in the most recent works of . Evans-Cowley, Lockwood, Rutherford and Springer (2009).

As an overarching comment, the published paper versions of these studies provide little insight into the theory behind the methods employed or rationale to the methodological selection process. In the majority of cases, the specifications are implied at best and any testing of model adequacy is omitted. There is little to no cross referencing of methodological advancement, even within the same author groups. Unfortunately, this lack of explicit detail stymies the exploratory and comparative process somewhat, and is a limitation of the archival research methodology employed in this research. Nevertheless, this research has provided an important analysis of existing models and identified outstanding methodological deficiencies. It has identified the 2009 model as perhaps the most evolved model of recent times, which may provide a sound starting point for models being developed outside of the US.

5. CONCLUSION

The purpose of this paper has been to analyse the various US econometric models that have sought to measure the effect of impact fees on new housing prices. A number of models had been identified, that appeared to have little consistency in approach and findings. This step has been important in identifying the most evolved/relevant model with a view to determining whether any of the existing models have external validity and is readily transferable outside of the US.

The findings conclude that there is very little explicit rationale behind the various model selections and that significant model deficiencies appear still to exist. However, the most recent published works from 2009 provides some guidance. This non-time series model is simple and well specified, and the econometric tools used seem to appropriately address the issues the cross-sectional data with endogenous forces driving the central variable

of interest, namely the impact fees, may suffer from. Therefore, it may provide an appropriate start in countries wishing to commence this level of analysis on the effect of impact fees on house prices and housing affordability.

Further research is required on this topic to delve into the implicit assumptions of a selection of these models. It is anticipated that any decision on the external validity of these models outside of the US would also need to consider the impact fee regime characteristics, property tax regimes and market functions of the US versus any other target study area.

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