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Land use for transport projects: Estimating land value

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ABSTRACT

Transportation projects are typically characterized by increased land use, which is a scarce resource of economic value. However, there is a tendency to ignore land value during feasibility studies of transportation projects. This may lead to a reduction in the economic efficiency of a project and to increased land use. This paper presents an economic model, based on the relationship between the elasticity of land price with respect to density, and estimating the future value of land designated for various uses, including transportation projects. The model was applied to transactional data from Israel, and was used for examining the value of land designated for two transport projects within Israel. The conclusions of the study indicate that taking the land value during a feasibility analysis of transportation projects into account, may lead to the consideration of other alternative plans, which may prevent the excessive use of land.

Introduction

Land is a scarce, non-renewable natural resource and is one of the most valuable non-produced assets for most countries (OECD, 2008). However, the price of land is exposed to various market failures and political decisions which may influence the way land is used (FAO, 2007). This problem is reflected particularly in the case of transportation projects, which are characterized by high consumption of land, imposing environmental and esthetic costs (Litman, 2004). It is estimated that 1.5–2.0% of the world's total land surface is occupied by transportation infrastructure, primarily for roads and parking lots. In urban areas, 30–60% of the land is taken by transportation infrastructure, and in some cases, this figure can reach 70% (Rodrigue, 2013).

Land designated for transportation purposes has significant economic value, mainly since many transportation infrastructures are located in close proximity to key destinations, in areas with high-value land (Litman, 2005). Continuous growth in demand for various land use (residential, employment, public, etc.), as well as the need to develop transportation infrastructure for transportation services, create a constant conflict when determining land uses. This situation leads, in most cases, to land resources that are directed to transportation projects at the expense of alternative designation which could have been determined for the land.

Often, land designated for transportation is incorrectly considered a sunk cost with little current value, even though there are alternative potential uses for the land (Litman, 2005, 2012; Litman and Doherty, 2009). Several studies indicate that when examining the feasibility of various transportation projects, there is no consideration of the land value, or the land is attributed a low economic value, unless it is necessary to purchase the land (Delucchi and Murphy, 2005; Ketcham and Komanoff, 1992). In fact, land value is not taken into account during economic feasibility analysis of transportation projects in many countries, such as Ireland (Goodbody Economic Consultants, 2004), the EU countries (TRIP, 2004) and New Zealand (Booz Allen Hamilton, 2005). In Denmark, economic feasibility analyses of transportation infrastructure projects include land value only if it is required to purchase it (TRIP, 2004). In the United States, land value is not taken into account when estimating transportation projects (Delucchi and Murphy, 2005). In Canada, land designated for roads is often regarded as a sunk cost (Victoria Transport Policy Institute, 2009). Underpricing these lands reduces the economic efficiency of such projects and may lead to high land consumption and loss of open spaces (Braid, 1995; FAO, 2007; Poole, 1997; Roth, 1996).

The distortion created when assessing the feasibility of transportation projects to be built on land that the developer (usually the state) is not required to pay for, causes a lack of efficiency when comparing various alternatives for a certain project, and when comparing different projects that compete for the same budget source.

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This leads to economic inefficiency in the allocation of resources of the economy, due to disregarding the land's opportunity cost. This opportunity cost results from the damage caused to the economy by preventing alternative use of the land. Therefore, a correct land valuation is an essential part of a sustainable management of land resources when conducting economic feasibility analyses of transportation projects. In some cases, an active land market exists for land designated for transportation projects. In many other cases, however, there is no active land market and the market price is difficult to estimate (Belli et al., 1998).

Non-market valuation techniques, such as the Hedonic Price Method (HPM), Contingent Valuation Method (CVM) and Travel Cost Method (TCM), are common methods used to estimate the value of non-marketable land. However, such methods require a specific valuation of the location in question. The aim of this paper is to create a uniform method for estimating land value for all transportation project feasibility analysis, allowing a comparison between projects, or between different alternatives for each project on a uniform basis.

In the economic literature, the conventional method of land valuation in the case of non-marketable land is based on the values of adjacent lands (e.g., Booz Allen Hamilton, 2005). For example, an area bordering a residential area is likely to be expanded into a residential neighborhood, an area bordering an industrial area is likely to be expanded into industrial area and so forth. This method can be technically challenging, since often areas adjacent to roads have a variety of land uses (Woudsma et al., 2006). Delucchi and Murphy (2005) argue in their study that when utilizing land for transportation projects, the cost that should be taken into account is the value of the land in the free market, meaning, the price the government would pay for the land were it not already the owner. According to a study conducted by Anas et al. (1997), the economic value of land should be considered in terms of price and taxation based on similar land which is in use, in order to prevent a distortion which would increase the land used for transportation at the expense of other uses. It should be noted that land used for applications such as industry or municipal residence, generates tax revenues, while land used for transportation typically does not. Reference to the price of land and tax implications is particularly significant in urban areas where land prices are high, because there is competition between the different uses (Vickrey, 1997). Litman and Doherty (2009) note in their study that the opportunity cost of land used for transportation in urban centers ranges between the value of adjacent land and urban periphery land.

However, a main problem remains when the land designated for transportation is not close to any kind of built-up area. Moreover, the construction of a transportation project is expected to set the land designation. This not only prevents alternative short and medium term land uses, but also damages the possibility to choose a different land use in the long term. The land valuation methods described above provide a current land valuation. However, we argue that based on the above, future rather than current land values should be considered when estimating transportation projects.

Classical models of urban economy assume that land value declines with the distance from urban centers (e.g., Alonso, 1964; Beckmann, 1969; Papageorgiou and Casetti, 1971). Many empirical studies have reported on this relationship as well. Yet, parallel to the decrease of land value, population density decreases with distance from the urban centers as well (Sun and Tu, 2005; Woudsma et al., 2006). The main reason that can explain this phenomenon is that transportation costs and travel time to city centers, which constitutes employment centers, increase with the distance from the urban centers (Cadwallader, 1996; Solow, 1972). Therefore, population density is an important parameter that can reflect land value, not only at city level, but also at state level. Higher density indicates a high demand for land, resulting in an increase in land prices in the area. Indeed, areas with higher density are usually characterized by higher land prices (Grimes and Liang, 2007). Furthermore, according to the economic literature, higher density leads to economic benefits resulting from economies of scale, known as agglomeration benefits (see Duranton and Puga (2004) for a literature review), which may be reflected in higher levels of rent and land prices. This supports the assumption that higher density is accompanied by higher land prices. Indeed, studies estimating land value consider the density parameter in some form. Woudsma et al. (2006), for example, estimate the land value occupied by transportation projects in Canada, by dividing the country into three geographic categories, according to the level of urban development: large urban areas with high density, small urban areas and rural areas. Hirshhorn (2003) proposes a system that will map the state into regions based on population density in each area (low, medium, or high), when the estimated value of the land is the average value for each region, and in urban areas with high-density, land value is estimated by the distance from urban centers.

The main purpose of this research is to offer an economic model for estimating the future land value for transportation projects. The model is based on the HPM and uses data from transactions of land with different characteristics. Some of the parameters that determine the land value change over time, and some, such as geographical location and land designation, are constant.

Since there is a global trend of increasing population density, which is a key factor in explaining the variation in land prices over time, we rely on the expected or planned density in a given area for estimating future land value. We demonstrate that the parameters changing over time can be represented by the density parameter. Thus, the presented model provides a basis for assessing the future land value based on land characteristics and the expected level of density in the area.

The paper continues as follows: Second section demonstrates the econometric model for estimating land value. Third section applies the econometric model on Israeli data, while fourth section presents two case studies of applying the model on transportation projects. Fifth section presents a discussion and the last section concludes the paper.

The model

When estimating the value of a specific land, a large number of variables should be examined. An appraiser's estimation, which gives a specific value to a certain land, examines many aspects such as location, proximity to services and/or institutions, attractiveness of the region and so forth. The demand for land is affected by various variables, which varies in importance from person to person. Estimating land value when analyzing the feasibility of a transportation project requires certain data uniformity. In addition, an appraiser's estimation is problematic, as it displays the current land value without reference to the future land value from the perspective of the economy. That is, there is no reference to the fact that the land is a limited resource while the demand for land is growing.

Lavee and Baniad (2013) estimated the value of non-marketable land in Israel, based on various measures, such as the distance from Israel's central region and socio-economic state. In this study, we assume that population density can represent an increase in demand. The purpose of the model is to estimate the land value based on the estimation of the relationship between land value and population density in the area where the land is located.

The model presents a uniform method for examining the total amount of land, while maintaining the highest level of accuracy as possible. The estimation is carried out by running a lateral regression on data of marketable land sale transactions, when the