



# The Millennium Villages Project and Local Land Values: Using Hedonic Pricing Methods to Evaluate Development Projects

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**Summary.** — This paper uses hedonic analysis to estimate the impact of an area-based anti-poverty project on land values in a developing country. Economic theory would suggest that benefits of area-based programs would be capitalized into land prices, as supply is relatively fixed compared to other factors of production. While revealed preference methods have been applied widely in the field of environmental economics, they have not yet been used to evaluate an international development project. We study the effects of The Millennium Villages Project (MVP) in Sauri, Kenya. Using administrative data from the Kenyan government on prices for land bought and sold within the MVP (established in 2005) and for land bought and sold in the surrounding area during 1999–2013, we estimate the project's effect on local land prices. We find no evidence that the MVP investments led to an increase in land prices within project areas. This research represents the first work to use hedonic analysis of land values to assess an international development project.

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*Key words* — program evaluation, impact evaluation, Kenya, Africa, millennium villages project, land markets

## 1. INTRODUCTION

This paper uses hedonic analysis of land prices to evaluate the impacts of a geographically targeted and multi-faceted international development project. Geographically targeted and multi-faceted projects share the following features: they are site based, with participant eligibility primarily determined by location; they tend to involve numerous, integrated activities which can include significant investments in infrastructure and public goods; and they are generally subjected to limited rigorous evaluation in part because of their sheer scale and complexity.

Economic theory suggests that benefits of area-based development programs would be capitalized into land prices, as supply is relatively fixed compared to other factors of production. Our research is based on a recognition that, in areas with functioning land markets, households are free to move to live within project boundaries and to thereby take advantage of new public goods and services being provided by projects. In light of those options: do households try to move into areas where such projects are sited? Does their decision-making and willingness to pay reveal a preference for living within the participant basins of such projects? Are households willing to pay a premium to live within the designated geographic territory of a large-scale development project? Might successful projects—successful in terms of increasing the quality of life within project boundaries—put upward pressure on local land prices in a way that could complicate net effects?

We use hedonic methods to analyze the effects of the Sauri, Kenya Millennium Village. We use data on land transactions that occurred during 1999–2013 which we transcribed from the administrative land records office in Siaya County, where the Millennium Village is located. The MVP is a large, high-profile development initiative which began activities in 2005. Participation is site-based and the project includes multiple simultaneous interventions implemented across sectors with considerable spending in public goods including health clinics, schools, infrastructure, and agricultural production and marketing support.

Because such large-scale, multi-sector development projects are often implemented without randomization, they can be a challenge to evaluate rigorously, though examples such as [Jalan and Ravallion \(2003\)](#) have succeeded. Moreover, implementers have sometimes argued that rigorous, quantitative evaluation using baseline and end-line data can fail to capture project benefits because the true effects are multi-dimensional and complex, or because the full benefits of the project could take many years to materialize, especially if the project is investing in human capital or health. Qualitative methods based on the subjective assessments of participants have the attractive feature of allowing respondents to evaluate a given project more comprehensively (that is, across numerous areas of project activity), but they can be compromised by response bias. Recent research by [Ravallion \(2014\)](#) found that participants' qualitative recalls of project impact showed weak and biased relationships with measures of change from quantitative data.

Hedonic land valuation is a method whose use is well-established in other areas of economics and which has been shown to reliably recover value of site-based amenities that are not traded in formal markets ([Parmeter & Pope, 2013](#)). In this paper, we treat the anti-poverty development project as a new amenity available to households living in a particular area. We compare the market value of land bought and sold within project boundaries with land bought and sold just beyond those boundaries, exploiting temporal variation in a project's siting. The method can provide insight into two critical areas related to project effects. First, we can assess whether

\* Thanks to University of Illinois and MIEDC seminar participants for comments. All views, interpretations, recommendations, and conclusions expressed in this article are those of the authors and not necessarily those of the supporting or collaborating institutions. The authors were postdoctoral researchers at Columbia University and affiliated with the Millennium Villages Project during the time that this research was initiated and the data was collected. Final revision accepted: June 16, 2017.

the project's activities and investment in public goods causes upward pressure on local land prices or whether project activities might depress land values relative to nearby areas. Second, differences in changes in land prices can indicate buyer and seller assessment of the discounted value of an anticipated stream of benefits from a given project.

We find no effect of the project on local land prices in the area of the Sauri, Kenya Millennium Village, suggesting that the significant increase in public goods investment did not result in any inflationary pressure on land values among households who sold and registered their land transactions during 1999–2013. In fact, we find that land values in the MVP cluster have not increased at the same rate as land transacted in bordering areas. Accounting for that disconnect can lead into speculations involving both economic and cultural factors: for example, a low expectation, possibly based on experience, that enhancement initiatives will have long-term effects on productivity, or cultural constraints with regard to raising prices for potential buyers who are members of one's own extended family or ethnic group. Whatever the reasons, a commonplace algorithm with regard to capital investment, an upward pressure on land prices, is not in evidence with regard to the Sauri MVP. Moreover, we find no effect of the project on the size of parcels of land transacted; in other words, the project does not seem to have increased the subdivision or fragmentation of landholdings among registered transactions.

An advantage of studying the Sauri, Kenya Millennium Village site is that the project benefits have been estimated in a previous analysis using more conventional impact evaluation methods—propensity score matching—and household-level outcomes that include a range of production and income measures. Consistent with our analysis, results from this existing evaluation suggest that initial project impacts on household incomes and wealth in the Sauri village may be more modest than the level of project investment might suggest. [Wanjala and Muradian \(2013\)](#) find that households living within the project boundaries had higher maize yields, higher “self-consumption” (market valued consumption from own production), and higher total income (including the value of consumption from own production) but that the project increased “agricultural dependency” and had no effect on household cash incomes. [Wanjala and Muradian](#) argue that their results are consistent with the results of an analysis conducted by an MVP team which found no effects on asset wealth attributable to the project ([Pronyk et al., 2012](#)).

This paper demonstrates that hedonic valuation using local land prices could provide a cost-effective way to measure program impacts, offering a complement or in some cases a low-cost alternative to standard impact evaluation methods such as randomized control trials or assessments using household survey data. One advantage of the sort of assessment we conduct is that it can be implemented retrospectively. In other words, because such analyses rely on existing administrative data they can be conducted in any site and to evaluate any project where land markets are thick enough and where good quality administrative data can be accessed on land prices including transactions which occurred in the years before and after a project's implementation. A second advantage is that revealed preference data can be relatively easy and quick to acquire and therefore can serve as a useful complement to impact evaluations relying on household survey data.

The remainder of the paper is organized as follows: [Section 2](#) presents the hedonic model and reviews the application of hedonic methods in other contexts. [Section 3](#) presents relevant context and details related to the Millennium Villages Project

and the Sauri, Kenya village site. [Section 4](#) describes the land transaction data. [Section 5](#) presents the estimation strategy and results. [Section 7](#) concludes.

## 2. LITERATURE

The revealed preference method we use is an application of hedonic demand theory, a method for estimating value proposed by [Rosen \(1974\)](#). Rosen was the first to write down the theory behind the market for heterogeneous goods. Based on Rosen's model, a property can be thought of as characterized by a vector of attributes. The price of the property, then, is a function of the quantities and qualities of these attributes. Characteristics can include structures on the property as well as access to local services, amenities, and public goods. Rosen's insight: because the property characteristics are bundled together they are not individually transacted in markets. Nonetheless, prices can be estimated by observing individuals' willingness to pay for bundles of attributes represented by a given property.

Formally, the price of the  $i$ th property can be written as a function of this vector of its  $1 - n$  attributes:

$$P_i = P(x_1, x_2, \dots, x_n)$$

The partial derivative of the price  $P$  with respect to characteristic  $n$  is the marginal implicit price of that characteristic in the overall price of the property and is used to estimate the welfare effect of a marginal change in a characteristic, such as the establishment of a new development project in a place where there was none before.

Since Rosen, hedonic pricing methods have been applied to a range of problems and contexts. More recent discussion of the method, in particular the increased use of hedonic analysis with quasi-experimental methods can be found in [Parmeter and Pope \(2013\)](#). Generally the methods have been used to assess real estate values, adopted by urban and environmental economists as a way of estimating the values of a range of property attributes or environmental amenities including air quality ([Chay & Greenstone, 2005](#); [Nelson, 1978](#)), noise pollution ([Pope, 2008](#)), and pollution ([Davis, 2004](#); [Gayer, Hamilton, & Viscusi, 2000](#)). For example, [Geoghegan \(2002\)](#) tests the extent to which a range of types of open spaces are capitalized into housing prices and [Leggett and Bockstael \(2000\)](#) assesses the effects of water quality on property values in the area of the Chesapeake Bay. Relatedly, the method is often used to estimate the value of environmental improvements on land or home values ([Palmquist, Roka, & Vukina, 1997](#)) or the improvement in public goods or infrastructure on land values ([Plantinga, Lubowski, & Stavins, 2002](#)).

Few applications of hedonic pricing have as yet been performed in the developing world. Ecosystem service valuations and amenity value studies were recently conducted in China ([Jim & Chen, 2009](#); [Zhao et al., 2004](#)) and an analysis of Ghanaian land values was carried out in 1981 ([Asabere, 1981](#)). To our knowledge, hedonic pricing methods have never been applied to the evaluation of the effects of international aid investments or development projects.

Our application of Rosen's method is as follows. We treat the area-based development project as representing a new set of amenities available to owners of properties that fall within the project's geographic basin. The price of the land transactions should capitalize the present discounted value of all future benefits from the project into the land price, potentially driving up the cost of land within the project area. We hypothesize that the project would fuel demand for land through two

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