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# Philippine House Consolidation: Estimating Changes in Housing Quality

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*The National Housing Authority has been instrumental in effecting physical improvements in the residences of Tondo, Metro Manila's most congested squatter community. The impressive pictorial records and tables indicative of the changes in housing quality in this slum district are analyzed in terms of statistical measures of upgrading dwelling units. The use of the hedonic pricing technique to obtain a price-consistent measure of change in housing quality is also described. The method anchors on the assumption that a house is a bundle of size, quality and location characteristics, and that the rent or value of a housing unit stems from the quality and type of characteristics it contains.*

## Summary Statistic: A Need

In one of the most innovative urban development projects in the world, the National Housing Authority (NHA) of the Philippines has changed the face of Metro Manila's largest squatter community — Tondo. The extensive slum upgrading effort known as reblocking included the rationalization of tenure, the provision of basic urban amenities and services, such as running water, sewerage, and roadways, and the availability of housing materials loans to assist in the movement. The changes, which have been described vividly in pictures and words in a report by NHA's Research and Analysis Division (RAD), have been dramatic.[1] Aside from the physical infrastructure provided by the NHA, physical improvements have taken place in the residences. The stimulus to invest in the dwelling units appears to have more than offset the dislocation caused by project implementation. This stimulus has been a response to a number of factors, but can be attributed mainly to the provision of tenure.

Although vivid and useful, documentation of the extent of improvement through the use of tables and the pictorial record of the reblocking process is not enough. For analytical purposes, a summary statistical mea-

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[1] Mila A. Reforma, "House Consolidation Study," Tondo Foreshore Dagat-Dagatan Development Project Report 80-2, National Housing Authority Research and Analysis Division, 1980.

sure of this upgrading is needed. Because housing is not a homogeneous commodity, it is particularly difficult to assess the net changes in housing quality, given the large number of characteristics which describe housing. Lot size, number of rooms, quality of materials, location, and many other variables have to be taken into account. A summary statistic would facilitate an overall view of the effects on housing, as some of the attributes may improve and others worsen as a result of the project. Such an estimate would be especially useful for future project planning, especially on the benefit side of the evaluation procedure. This paper will attempt to describe a particular method of performing this estimation.

One simple method would be to form an overall housing quality index by adding up all the measures of quality whch have been collected.[2] While it may provide certain insights into the direction of change, the magnitudes would not be appropriate because of the assumption of simple aggregation. It may be, for example, that floor areas have not improved much but the walls have. The net effect obviously depends on the relative weights of the particular housing components in making up the overall index. Assuming that each component of quality has equal weight is most likely unrealistic. On the other hand, there may be no reasonable basis for arbitrarily assigning the weights. Another problem is how to add qualitative and quantitative measures.

Another approach would be to obtain measures of the value of the house over time, with at least one measure before the project. Aside from being costly to obtain (if an appraiser is used), there is the problem of correcting for the inflation factor. Changes in a dwelling's value may be a reflection of movements in price only. Moreover, these changes in price may reflect only demand forces, say for the land (or the location). Thus, changes in value may not truly capture changes in housing quality.

### *Hedonic Pricing Techniques*

The approach taken in this paper is, in a way, a combination of those described in the preceding two paragraphs. It uses hedonic pricing techniques to obtain a price-consistent measure of change in housing quality. The "implicit" market is first allowed to determine the contributions of the various housing components to value. Once the appropriate pricing structure is determined, quality and quantity measures are then used to generate "implicit" price deflated measure of value. This method is described in more detail below.

### A Brief Review of Methodology.

Like most durable goods, housing is difficult to measure. It is not easy to determine "how much" housing one household is consuming versus another. Housing units are different from one another in terms of characteristics. Not only are they of different sizes and shapes (quantity) but they also vary with respect to their structural conditions and the materials used to build them (quality),

[2] A variation of this method was employed in Bamberger, *et al.*,, "El Salvador Final Report," The World Bank, DEDRB, 1980, Mimeo.

the availability of services, and location. The prices of housing units are presumed to reflect these characteristics. After all, the price or value of a house should be nothing more than the sum of the value of its constituent parts. A crucial question would then be how housing characteristics interact with one another to determine the value of the house. How much would another room versus the availability of sanitary facilities contribute? The hedonic price method purports to answer this. This technique essentially dissects the rent or value of a unit into a number of components which can be individually measured and compared.[3] For example, the number of rooms in a dwelling is a frequently employed component; other examples include the number of baths, the age of the unit, and the type of materials used. Prices are estimated for each of these components via multivariate regression. These prices can then be used to compute a standardized measure of housing quality. The measure, for any housing unit, is simply a weighted average of the components embodied in the unit, where the weights are the estimated prices of the components.

The hedonic method is based upon important assumptions. The first, and least controversial assumption is that a house is a bundle of size, quality, and location characteristics. An analogy can be made to a bundle of groceries. Some grocery bundles are bigger and better than others, depending upon the number and type of food items in the bundle; so too with housing. A house embodies many features: bedrooms, baths, location, and so on. The number and types of features embodied in a particular house distinguish it from other houses.

How can housing bundles be compared? It is simple to compare houses which contain the same number and type of all features except one; for example, a two-bedroom house contains more housing than an otherwise identical one-bedroom unit. Problems occur when units differ in more than one attribute at a time. For example, does a three-bedroom unit with two baths represent more housing than a four-bedroom house with one bath? It depends, of course, on the value of the bathrooms relative to a bedroom. The problem is easily solved in the grocery bundle example because all individual items have clearly marked prices. The more expensive bundle clearly represents more groceries. This follows because the money used to buy the expensive bundle could be used to buy the less expensive bundle and there would still be money left over to buy more groceries.

Unlike groceries, prices of the individual features which comprise a housing bundle are not directly observable. This is where the second assumption comes in. The second assumption is that the rent or value of a housing unit stems from the quantity and type of characteristics it contains, and that the "prices" of the characteristics can be estimated from the rents or values of many units via multivariate regression analysis. A simple example which demonstrates the reasonableness of this assumption concerns the difference in values between two units which differ only with respect to the type of cool-

[3]The following verbal exposition of the technique is attributed to Professor James Follain of Syracuse University.

ing system. If one unit has a central air conditioning system and the other has a system of overhead fans, then the difference in the market value of the two units will equal the market valuation of a central air conditioning system relative to a fan. Not all examples are so simple, but by pooling together many dwellings it is possible for multivariate regression to determine the relationships between rents and dwelling attributes. The result of the regression is a set of implicit prices which measure the value of each dwelling and neighborhood attribute. For example, the regressions might determine that a central heating system adds one thousand dollars, or 10 percent, to the value of the house.

The basic premise of hedonic price analysis, then, is that there exists a reasonable well-fitting relationship between the prices of the goods in question and the characteristics of those goods.[4] In the most general functional form, this relationship can be represented as:

$$(1)\quad V = f(C_1, C_2, \ldots, C_N)$$

where V is the price (or value) of the house (expenditures on a housing unit) and the C's are the characteristics of the house (number of rooms, lot size, and so on). The exact relationship between the characteristics of housing and the price is not known. We assume that this relationship can be expressed in the linear form:

$$(2)\quad V = p_o + p_1C_1 + p_2C_2 + \ldots + p_NC_N + \text{error terms.}$$

This equation can then be estimated using linear regression analysis.[5] The coefficients of the characteristics can be interpreted as the shadow price of that characteristic.[6] For example, if $C_1$ denotes the number of rooms, $p_1$ would measure the contribution of an additional room to the total price (or value) of the house.

The hedonic equation will be most useful in evaluating the changes in housing quality over time. The data base from the RAD Monitoring and Evaluation Program provides for data on housing characteristics in two time periods: one observation before the structure was affected by the reblocking effort, and another observation six months after a particular structure was affected. The first task would be to use the first period data (which also contains information on the estimated value of the house) to estimate a hedonic equation of the form:

$$(3)\quad \hat{V}^o = \hat{p}^o_o + \hat{p}^o_1\hat{C}^o_1 + \hat{p}^o_2C^o_2 + \ldots + \hat{p}^o_nC^o_n$$

where the superscripts indicate the initial period. Equation (3) is estimated for the full sample. We postulate that $p_i$'s capture the market prices of the $i^{th}$ characteristic. However, because only a part of the full sample has moved, we use (3) to generate $\hat{V}^o$, which is the estimated value of a dwelling in the initial period and which was subsequently affected by reblocking.

[4] Zvi Griliches (ed.), *Price Indexes and Quality Change* (Cambridge: Harvard University Press, 1980).

[5] Assume that the errors are randomly distributed and are not correlated with one another.

[6] Sherwin Rosen, "Hedonic Prices and Implicit Markets Product Differentiation in Price Competition," *Journal of Public Economy*, Vol. LXXXII, pp. 34-35.

In the second period, the housing value would be $V^1$. Strictly speaking $V^o$ would not be comparable with $V^1$ as a measure of quality change since prices may have changed in the meantime. Since housing prices are hard to measure due to the indivisibility of the good, we cannot simply divide housing out. However, if we substitute the estimated hedonic coefficients from (3) into an equation using characteristics in the second period, we should be able to get an estimate of $V^1$ in terms of the initial period prices:

$$(4)\ \hat{V}^1 = \hat{p}^o_o + \hat{p}^o_1 C^1_1 + \hat{p}^o_2 C^1_2 + \ldots + \hat{p}^o_n C^1_n$$

The relative change in housing quality could then be estimated as:

$$(5)\ \Delta Q = \hat{V}^1 / \hat{V}^o$$

Other measures of change will also be presented.

*Data.*

The estimation strategy, then, is as follows: (a) the hedonic prices have to be derived by the multivariate regression of equation (3); (b) an estimated housing value of pre-reblocking ($V^o$) will be derived by the predicted values of the dependent variable of equation (3); and (c) an estimated housing value of post-reblocking ($\hat{V}^1$) will be derived via equation (4). But how should housing value be measured?

## Hedonic Estimation Applied

The informal market, by definition, operates in a world which is beyond the scrutiny of conventional government activity. Since data and tax collection agencies do not enter this world, legislated restrictions such as minimum servicing requirements for housing are irrelevant. It is thus not a trivial task to study the market for squatter dwellings when selling prices are not recorded because the transactions whence they originate are, in effect, illegal. In the absence of these recorded prices, the National Housing Authority's RAD was very resourceful in obtaining information which is the key to the study of any market-value.

RAD researchers assembled various estimates of housing value. Five estimates were obtained: the owner's own appraisal; that of an architect under the employ of the National Housing Authority; that of an independent consulting engineer; that of a housing contractor, and the assessment of the household's immediate neighbors. It is postulated that the true market value lies in the neighborhood of the assessment. Because of possible biases (the architect was not well trained; the housing contractor might overestimate because he was asked how much he would charge to have a similar house built, and the highest or lowest neighbor's estimate was not coded), only two assessments are reported in the analysis of hedonic prices — the consulting engineer (CONSVAL) and the owner's own evaluation (OWNRVAL).

*Results of the Hedonic Estimation*

The estimates of the coefficients of equation (3) are derived from the estimating equations used by Jimenez.[7]

[7] For a more detailed discussion of the hypotheses concerning the inclusion of these variables and the results of the estimation, see Emmanuel Y. Jimenez, "The Value of Squatter Dwellings in Developing Countries," World Bank Urban and Regional Report (1980), also forthcoming in *Economic Development and Cultural Change.*

Table 1. Hedonic Price Equations[1]

| | DEPENDENT VARIABLE = OWNRVAL | | DEPENDENT VARIABLE = CONSVAL | |
|---|---|---|---|---|
| | $p_i$ | $\beta$ | $p_i$ | $\beta$ |
| CONSTANT | -12505.18** | | -11760.84** | |
| | (6074.47) | | (5938.35) | |
| AGE | 252.38* | .13 | 11.13 | .01 |
| | (186.65) | | (182.47) | |
| AGE2 | | | | |
| CMNTWALL | 9755.09** | .27 | 7717.80** | .18 |
| | (4033.39) | | (3943.01) | |
| FINWALL | 7562.89** | .17 | 16998.20** | .32 |
| | (4586.22) | | (4483.45) | |
| QSTRUCT | 967.98 | .06 | 1840.39* | .09 |
| | (1543.07) | | (1508.49) | |
| SOLIDF | 8820.92** | .18 | 9294.42** | .16 |
| | (4701.87) | | (4596.51) | |
| QFLOORS | 1406.43 | .09 | 3634.43** | .18 |
| | (1582.58) | | (1547.12) | |
| QSTAIRS | 1018.30 | .06 | 927.39 | .05 |
| | (1494.18) | | (1460.70) | |
| LOT | 4.30* | .13 | 10.63** | .26 |
| | (2.97) | | (2.91) | |
| LOT2 | | | | |
| STORY | 5611.96** | .17 | 7380.79** | .18 |
| | (3326.67) | | (3252.12) | |
| TOILET | 587.15 | .02 | 1242.75 | .03 |
| | (3510.69) | | (3432.03) | |
| WATER | 6696.91* | .18 | 1167.66 | .03 |
| | (4254.75) | | (4159.40) | |
| RICH | 5035.87** | .15 | 1172.20 | .03 |
| | (2802.67) | | (2739.86) | |
| $R^2$ | .51 | | .69 | |
| N | 96 | | 96 | |
| F | 7.21 | | 15.21 | |

[1]Standard errors are in parentheses
*Coefficients larger than standard error
**Significance at .10 confidence levels (two-tailed test)
B's are coefficients of standardized variables

These are reproduced in Table 1. As the equations have been discussed elsewhere, we will not go into detail concerning their specifications. Table

Table 2. Appraised Values of Squatter Housing (in pesos)

| Variable | Description | Mean |
|---|---|---|
| OWNRVAL | Owner's assessment | 14,145.83 |
| ARCHVAL | NHA architect's assessment | 9,306.67 |
| CONSVAL | Independent consulting engineer's assessment | 14,092.08 |
| CONTVAL | Contractor's assessment: what firm would charge to build similar house | 17,467.08 |
| NEXTVAL | Average assessment of four neighbors around each house in the sample | 11,431.25 |

2 contains a description of the variables.[8] For the 96 observations in the sample, the signs of the coefficients of Table 1 are expected ones. Increases in quantitative and qualitative measures have positive effects on value. The materials used in the walls, exterior wall finish, and the materials used in the foundation appear to make the largest contribution to determining value. The one coefficient possessing a sign which may differ from expectation is age. As discussed by Jimenez, age's positive effect on value may be a reflection of the desirability of longevity (and thus reduced risk in a squatter community) and progressive development.

*Results of the Value Comparisons*

The differences in the average characteristics which can be observed before and after reblocking are shown in Table 3. By most measures there has been some sort of improvement in housing quality. The changes are especially evident in the greater proportion of households with solid walls and concrete foundations. Building areas are also somewhat larger on average, as is the average number of floors. The proportion of structures with water connections declined slightly, probably because of delays in water provision in the project. But it is also evident that there are other characteristics which have actually declined. Lot areas have decreased, and, of course, the structures have aged. What is the next effect? This is why we need to use the hedonic equations.

The dramatic overall increase in housing quality is most clearly seen in Table 4, in which the "after reblocking" measures of each variable (see Table 3) are used to generate a series of housing values across all observations by using the estimated weights (hedonic prices) of Table 1. Based on the estimated values of housing, after only six months, overall housing quality in Tondo has increased by *60 to 85 percent.* In monetary terms, the absolute difference in housing quality before and after reblocking

[8]The following variables are not explained in Table 1: QSTRUCT, QFLOORS and QSTAIRS. These variables measure the quality of the structure, floors, and stairs, respectively. The magnitudes are derived from a factor analysis application on a series of subjective measures of quality (see Jimenez, *op. cit.*, 1980).

Table 3. Housing Characteristics in the Tondo Area

| Variable | Description (Averages) | Mean Before Reblocking for Affected Sample[1] | Mean After Reblocking for Affected Sample[1] |
|---|---|---|---|
| AGE | Age of the structure in years | 8.58 (4.25) | 10.2 (4.45) |
| CMNTWALL | Proportion of dwellings with solid (cement or brick) walls | .16 (.37) | .47 (.51) |
| FINWALL | Proportion of dwellings with wall finish (e.g., paint) | .03 (.28) | .05 (.16) |
| SOLIDF | Proportion of dwellings with concrete foundations | 8.0 (.27) | .26 (.45) |
| LOT | Average lot size in square meters | 61.3 (64.5) | 57.6 |
| BUILD | Average building area in square meters | 32.1 (16.3) | 53.4 (15.3) |
| STORY | Number of floors | 1.4 (.50) | 1.6 (.50) |
| TOILET | Proportion of dwellings with bucket-flushed or other water-sealed toilet | .29 (.46) | .50 (.51) |
| WATER | Proportion of dwellings with sink (and water connection) installed | .92 (.27) | .84 (.37) |
| RICH | Proportion of dwelling in neighborhoods (superblocks) with monthly average incomes above 1,000 pesos | .26 (.45) | .26 (.43) |
| | Number of Observations | 38 | 38 |

[1]Standard deviations in parentheses.

ranges from a value of 6,200 to almost 8,000 pesos (approximately US$800 to $1,000). It is thus apparent that, at least for this sample, the Tondo project has been successful in stimulating housing investment and, more importantly, this investment has been effective in raising overall dwelling unit quality in the area by a substantial magnitude in a short space of time.

The figures quoted above hold for the average. There are some households whose quality indices decreased after reblocking. This result is not

Table 4. Estimated Average Values Before and After Reblocking

| Dependent Variable of Hedonic Equation | OWNRVAL | CONSVAL |
|---|---|---|
| (1) Actual Mean Value Before Reblocking | 9921.05 | 8810.61 |
| (2) Estimated Mean Value[1] | | |
| (a) Before Reblocking | 10262.98 | 9385.02 |
| (b) After Reblocking | 16508.09 | 16820.30 |
| (3) Difference Between Before and After | | |
| (a) (2b) - (2a) | +6245.11 | +7425.28 |
| (b) (2b) - (1) | +6587.04 | +7999.69 |
| (4) Difference as Percent of Before Reblocking | | |
| (a) (3a)/(2a) | 61% | 79% |
| (b) (3b)/(1) | 66% | 85% |
| (5) Relative Difference | | |
| (a) (2b)/(2a) | 1.61 | 1.79 |
| (b) (2b)/(1) | 1.66 | 1.85 |

[1]Generated from equations estimated in Table 2.

Table 5. Distribution of Households According to Changes in Overall Housing Quality and Individual Quality Measures

| | Proportion of HH for Whom Value of Variable After Reblocking < Value of Variable Before Reblocking | Proportion of HH for Whom Value of Variable Before = Value of Variable After | Proportion of HH for Whom Value of Variable After > Value of Variable Before |
|---|---|---|---|
| Overall Housing Quality | .34 | — | .66 |
| Overall Housing Quality (Based on CONSVAL) | .37 | — | .63 |
| CMNTWALL | .03 | .63 | .34 |
| FINWALL | .03 | .92 | .05 |
| SOLIDF | .05 | .71 | .24 |
| LOT | .47 | — | .53 |
| BUILD | .11 | — | .89 |
| STORY | .11 | .61 | .29 |
| TOILET | .05 | .68 | .26 |
| WATER | .13 | .82 | .05 |

surprising given the short time period which had elapsed between the implementation of reblocking and the time of the second interview. It is apparent that some households (about 34-37 percent) were not able to suf-

ficiently upgrade their dwellings to their original states after the initial displacement caused by reblocking (see Table 5). The number of people for whom the quality index declined indicates that, in order to obtain the relatively large and positive net gains over the whole sample reported in the previous paragraph, the households who did upgrade quickly also did so on a very large scale. It is also not clear to what extent other variables, such as socioeconomic characteristics, determine the ability to improve the overall quality measure.