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Determination of a Price Index for Escalation of Building Material Cost in Nigeria

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Abstract: *The major problem facing the building industries is changing in prices of different items such as cement, block, house rent, etc. The main objective of this study is to develop statistical analysis to measure the price index of house rents in different location in Ilorin metropolis and compare these house rents with the price building materials such as cement and block for a period of time. Profit index analysis was used to measure the change in price and compare it with price of building materials. With this analysis Both the Government and stakeholders will be able to plan ahead, in other to find the solution to the problem of building scarcity.*

Keywords: *Price Index, Escalation, Correlation, Regression Analysis.*

1. Contribution

Price index of items determines the values of such items; some items have their value increase over the period of time. Time items that belong to such categories include landed properties such as buildings, pieces of land, and other related items. In this study we try to take into consideration the price index of items that their price and values keeps on increasing over the period of time. Comparison of prices of some of the items that are normally used in building construction is analyzed to determine the price change over some period of a time.

2. Introduction

Nigeria is one of the developing countries in the world, this challenges causes scarcity of houses in Nigeria in which the working classes are mostly affected. This major problem affects mostly averages Nigerian such as scarcity of houses, Education, transportation and many others. The main reason is that price of items such as cements, blocks, houses rent keep on changing in geometric progression while the rate of income are increasing in arithmetic progression.

With the problems mentioned above, it’s very difficult or impossible for the working class to have their own houses. This paper tries to focus on the price index analyses of some items that are used in building industries. We try to compare the price changes over time.

The main objective are;

1. To bring to the awareness of the government the change in price of the building items
2. To bring to the awareness of the people of Nigeria in price change

3. Enable both the government of Nigeria to plan ahead to avoid scarcity of building and related items such as road construction.

2.1 Brief History of the Study

According to Chance,(1966) **price index** (plural: “price indices” or “price indexes”) is a normalized average (typically a weighted average) of price relatives for a given class of goods or services in a given region, during a given interval of time. It is a statistic designed to help to compare how these price relatives, taken as a whole, differ between time periods or geographical locations.

Price indexes have several potential uses. For particularly broad indices, the index can be said to measure the economy's general price level or a cost of living (Diewert,1993). More narrow price indices can help producers with business plans and pricing. Sometimes, they can be useful in helping to guide investment.

SSI Turkey (2002) defines the price index as a tool which measures the rate at which the prices of goods and services are changing over time. A basket of goods and services according to the market under interest (consumer, producer, export, import, etc.) and representing this market is established and the prices of the selected materials are monitored periodically. The price indices are named according to the good and service market where the prices are monitored. The consumer price index, producer price index, export price index, import price index can be examples for these indices.

Building materials and construction cost indices are developed to measure the degree of price variations in material and labor costs. However, each specific type of construction is a combination of unique set of materials and labor. This leads to the fact that cost variations for different types of constructions shall be measured by different types of cost indices, which actually are developed by measuring the price variations regarding those specific sets of material and labor involved in those kinds of construction projects.

The objective of this study was to examine which cost index, among Consumer Price Index (CPI), Producer Price Index (PPI), Building Cost Index (BCI) published by the State Statistic Institute, Cost Index (CI) published by Ministry of Public Works and Settlement and the Cost Indices produced in this study using the data compiled from the database of several Nigerian contractors, would provide the most precise result to be used for the escalation purposes of building projects in Nigeria. In addition, it was aimed to develop models to predict the future values of the most precise two cost indices selected to assist for cost estimating of the building projects.

Determination of the current value of a past project plays an important role in the procurement process, since the applicants of any tender process could be compared in terms of the amounts of the projects completed by them in the past.

In this aspect, the past projects of the contractors could be compared quantitatively, either in the prequalification or post qualification process. The base of comparison usually and mainly depends on the projects completed by these contractors, examining the contract prices of those completed projects, besides other criteria regarding the technical and administrative issues. However, since the periods of the execution of the projects for each contractor may vary in time, the impact of inflation should be included in these comparisons.

Escalation is not only used to determine current value of the past projects; but also to predict the future costs of the construction projects. As most of the construction projects usually take several months to complete, costs are expected to increase during the construction of the project, even with the decreasing inflation rates achieved in Nigeria over the last decades.

In most of the contracts which the payments are going to be made in TL, a method for the escalation of construction prices is included. In the majority of these contracts, especially for the public projects, price escalation is calculated by a formula which is a linear function of the producer price index published by the State Statistics Institute. In some projects where payments are made in TL, there may be no price escalation included in the contract. For these projects, the contractor should estimate future construction costs for the contract period and include these costs in the bid amount. Payments could be made in foreign currencies for some projects that are contracted in Nigeria. Even the payments are going to be made in foreign currencies, the contractors bidding for these projects should also consider possible increases in the construction costs in Nigeria, as most of the time local labor and material are used by the contractors.

This study will not be complete without briefly giving the literature review related to this study

The Producer Price Index (PPI) published by the State Statistics Institute and the Cost Index (CI) published by the Ministry of Public Works and Settlement are commonly used for the escalation purposes of building project costs in Nigeria.

Many studies have been conducted to develop special price indices for different types of construction projects; each calculated by using different weights assigned to the rates of price changes of material and labor costs included therein. The developed price indices were also tested to define how much they could describe the price variations in the costs of the subject types of projects.

On the other hand, some of the studies were performed to select the most applicable index among the available ones. This chapter aims to present information about previous studies regarding price indices developed for different types of projects, with detailed explanations about the calculation techniques.

Pintelon and Geeroms (1996) touched on the subject of deficiency of plant cost indices to be applicable for countries other than US. Their study referred to the utilization of these cost indices and development of them for a non-US country. In the past research, the authors illustrated development of a cost index for chemical process plants in Europe, more specifically in Belgium. Pintelon and Geeroms (1996) conducted this study with the involvement of the data regarding the cost escalation period from 1965 to 1994. As cost indices have no dimension, a base year was assigned according to the available data. Then they obtained cost indices by dividing the actual price in a given year by the price in the base year, and multiplying the result by 100. The actual price in a given year was calculated by taking the average of the unit prices throughout the given year into consideration. Remer, Huynh, Agarwal, Auchard and Nelson (1998) stated that the inflation and location indices were used in order to adjust costs for time and location.

Hence they focused on the use of these indices, different types of indices available, and some caveats. As Remer et al. (1998) stated, a cost estimator would adjust the variables like time and location when the cost of similar projects was available. At this point, the usage of cost index came into scene in order to make this calculation. On the other hand, selecting the most suitable index to use was actually the main problem in using inflation indices. The authors illustrated *a large number of indices to help the cost estimators locate the correct one to use.*

There were four types of cost indices: compiler intent, measured cost, industry and location. Compilers use cost indices for the following: general purpose, contractor price, valuation and special purpose. General purpose cost indices cover a broad spectrum of a particular industry or a type of cost, such as the engineering news record (ENR) index (Remer et al., 1998). On the other hand, the authors mentioned that contractor price indices measure the change in selling prices of various types of buildings, such as the Turner general building index.

They also defined valuation indices and special purpose indices as representing replacement costs, such as the Marshall and Swift industrial equipment index and being used for a particular industry, such as the Nelson-Farrar Refinery Cost Index or the Handy Whitman Public Utilities Index respectively.

Remer, Huynh, Agarwal, Auchard and Nelson (1998) used the data of 70 indices by dividing these data in two groups which are US Indexes and International Indexes. The US Indices contains indexes applicable to projects located within the US, on the other hand, International Indexes contains indexes compiled with data from areas outside the US. They also categorized these 70 indices according to their industry category, type of cost category, and descriptions to find potentially useful indices. In order to find the most appropriate cost index to be used, they suggested contacting index compilers for detailed information on how the indexes are constructed. Finally, Remer, Huynh, Agarwal, Auchard and

Nelson (1998) gave a list of caveats in using inflation and location indexes as follows:

• Inflation indexes are statistically weighted composite averages, and thus, should only be used for ballpark or order-of-magnitude calculations.

• Inflation indexes are usually limited in scope to a particular industry or industrial segment. As noted by Miller, the engineering news record construction index may be misapplied in the process industries (Park, 1973). The ENR Index was intended for use with civil engineering projects involving large quantities of unskilled labor, which may not be the case for process plants or process plant equipment.

• Inflation indexes measuring similar types of cost may be constructed of different weighted averages of sub-costs. For example, the Bureau of Labor Statistics compiles two Employment Cost Indexes for various types of workers, one for benefits and the other for wages and salaries (Monthly Labor Review, 1995). Examining the cost measured by a particular inflation index and how the index is calculated increases the probability of accurate cost estimate calculation.

• Some indexes do not account for radical technological changes in design and construction. As technology progresses, the cost weightings for a particular index can change, which may or may not be reflected by the inflation index. For example, production technology developments may shift manufacturing costs from labor to plant equipment. An inflation index tracking the manufacturing cost may not adjust to these changes.Cost estimators should always check the applicability of cost indexes used in their calculations.

• Inflation indexes compare costs for products that evolve over time.

Comparing the cost of a chemical plant constructed today versus 20 years ago should reflect not only the increased cost of materials, but also the additional cost of government-mandated environmental equipment. Cost estimators should be aware that some inflation indexes do not adjust for these additional costs.

• Inflation index calculations become increasingly inaccurate as the time interval between data points is increased, i.e., a 5 year calculation is probably more accurate than a 20 year escalation.

• Some inflation indexes are based on published list prices (rather than market prices) and time averaged labor conditions. These indexes can be insensitive to short-term economic cycle swings.

The study by Remer and Mattos (2003) updated and expanded upon the study by Remer, Huynh, Agarwal, Auchard and Nelson (1998) on cost and location factors used in the US and internationally. In their study, 43 US cost and location factors and 30 international cost and location factors for 12 countries were used.

In addition, cost scale-up factors for a wide variety of equipment, plants and processes from air pollution abatement to waste-to-energy facilities were presented. Remer and Mattos (2003) reviewed the use of these indices and scaleup factors, and presented caveats for their use.

Wilmot and Cheng (2003) made a study in order to develop a model that estimates future highway construction costs in Lousiana. They stated that when projects are costed, their costs are estimated in terms of the current cost of the project, and this estimate is not adjusted for the year in which the project is scheduled for implementation. These cost increases can be significant and are, of course, cumulative across projects; also, they rise at an increasing rate each year into the future. Estimating future highway construction was the focus of their study. In order to describe the change in overall construction costs in the future, a predictive construction cost index was adopted in their study.

Wilmot and Cheng (2003) used the data of 2.827 highway and bridge contracts, which were obtained of highway construction projects let by the Lousiana DOTD during the period 1984-1997. Five submodels of price estimation were formed in order to predict overall highway construction costs. In their study, the most influential factors were found to be the cost of the material, labor, and equipment used in constructing the facility. On the other hand, characteristics of individual contracts and the contracting environment in which contracts were let also affect construction costs. In particular, contract size, duration, location, and the quarter in which the contract is let were found to have a significant impact on contract cost. Bid volume, bid volume variance, number of plan changes, and changes in construction practice, standards, or specifications also make a significant impact on contract costs.

The model developed by Wilmot and Cheng (2003) reproduced past overall construction costs reasonably accurately at the aggregate level. Predicted overall construction costs were not significantly different from observed costs at the 99% level of significance. The model estimated that highway construction costs in Louisiana were going to increase more rapidly to the year 2015 than would be anticipated if past trends were extrapolated or if the rate of general inflation were used as an estimate of future increase in costs. The authors stated that their model would be used by highway officials in Louisiana to test alternative contract management strategies. Increasing contract sizes, reducing the duration of contracts, reducing bid volume and bid volume variance, reducing the number of plan changes, and reducing the proportion of contracts let in the fourth quarter all serve to reduce overall construction costs. They also mentioned that highway officials would assess the impact of strategies they believe were achievable by applying the model. Finally, it can be said that, the model would assist in estimating future construction costs and providing the means to produce more reliable construction programs.

Wang and Mei (1998) made a model for forecasting construction cost indices in Taiwan. The major determining factors to make up the construction cost indices were mentioned as:

1. The number of difference

2. The required periods of preceding construction cost indices

3. The weight associated with each preceding construction cost index

4. The mean value of the series of construction cost indices that have been converted into a stationary series

5. The estimation of the errors between the predicted values of construction cost indices and the observed values of construction cost indices Focusing on the above mentioned factors Wang and Mei (1998) set up an analytical model in order to predict the current and future construction cost indices. Then, they tested the feasibility of the model by using the observed data of the construction cost indices obtained from the Executive Yuan of the Republic of China. After setting up and testing the model, the results showed that the model is adequate in forecasting the trend values of construction cost indices and can also provide the predicted values of them in Taiwan.

2.2 Literature Review

The Average Method

To get a better understanding of using price index analysis, it is better to discuss some of this method as follow:

The average method is the simplest way of constructing house price indices. This in fact is a hedonic regression where we ignore all characteristics but the period of sale. Even though it is sometimes ignored, the starting point of the method is to define a homogeneous segment of the market. Usually, a property type like flat or detached houses can be considered in a city or in a region. After defining the market segments, data would have to be collected on the transaction prices of the properties which have been sold during each time increment.

If a monthly index is to be constructed, then the transaction prices have to be collected on a monthly basis. For quarterly indices also, the prices are collected for each quarter etc.

When this data is available, then the average price per period or for each time increment can easily be computed. There are two ways of computing the average price per period.

These are the mean and the median.

The mean price per period is also calculated by dividing the sum of all the transaction prices per period by the number of properties sold per period. Mathematically, the mean price for each period is computed as follows:

The median price on the other hand refers to the average price indicated by the middle value or values in the house price series at period t. If Nt is odd, the median price is simply the central/middle value. However, if Nt is even, then the median price is the mean of the two central values.

The index can then be simply constructed on the basis of the average price (whether mean or median) per period already computed. In doing this the first period's average price is normalised to 100 and the changes in the index series are computed based on this first period's average price.

Advantages and disadvantages of the average method

The average house price index method is easy to construct. The method does not require any regression specifications. The method also requires less data for its implementation. Only the transaction prices and selling dates are needed to estimate the index numbers.

However, the method does not take account of the fact that the housing market is heterogeneous and that different types of properties are transacted at different periods. For example, detached houses are different from flats, and houses with garages are different from similar houses without garages. These differences influence the prices to pay for each property. These differences and the fact that housing characteristics can change over time are not controlled for by using the average method. The lack of standardisation or a constant-quality attribute of house price indices is therefore the main drawback of the average method of index construction.

The Hedonic Regression Method

The hedonic method can be used to construct house price indices by employing two main models. These are the explicit-time variable hedonic model and the strictly cross-sectional hedonic model.

Explicit time variable hedonic index (ETV) model

The explicit time variable model groups all the data for adjacent time periods and then includes discrete time periods as independent variables. Thus, the implicit prices of housing and the coefficients of time-dummy variables are estimated using a single regression. The estimation is done by regressing the natural logarithm of the selling price on a constant, the period (for example quarterly) time dummies and a number of observed independent variables.

The model assumes that the implicit prices of physical the presence of two bedrooms may have more influence on house prices in 1994 than it did in 1989 (Costello and Watkins, 2002).

Strictly cross-sectional hedonic index (SCS) model

The strictly cross-sectional hedonic model is an alternative to the explicit-time variable hedonic model and helps to control for the potential changes to the implicit house price attributes over time. With this model, the implicit characteristic prices are estimated in a separate hedonic regression for each time period thereby allowing the implicit attribute prices to vary over time (Gatzlaff and Ling, 1994). That is, the same regression equation is used to run a separate regression at each period using each period's cross-sectional data.

This model uses a similar functional form like the one illustrated above. However, the time dummies are excluded from the equation because a new regression is run for each period using the same equation.

In order to construct the index from the above equation once estimated, a chronologically ordered set of houses is estimated for a given bundle of characteristics using each of the cross-sectional models. Thus, using the same set of housing and locational characteristics for a "hypothetical house", a predicted transaction price (in log) is obtained for each period. Since the regression equation is estimated using the semi-logarithm functional form, we take the exponent of the predicted log prices to be the absolute predicted prices.

The differences between these predicted prices at each period are used to construct the index numbers (Meese and Wallace, 1997). When the initial or base period's set of housing and locational characteristics are used as the weights to estimate the periodic house prices, it is called the Laspeyres price index.

Advantages and disadvantages of the hedonic index method

One clear advantage of the hedonic method is that it corrects for the effects of heterogeneity of properties by taking the characteristics of the properties into consideration. The resulting indices are therefore able to monitor price changes in a reliable manner.

One major disadvantage of the hedonic method is omitted variable bias (Meese and Wallace, 1997). This bias occurs when important physical or locational variables are omitted from the analysis. The problem becomes more pronounced when the implicit prices of unobserved attributes change over time. In this case, the estimated hedonic indices will give a misleading impression as to constant-quality house price changes over time (Goetzmann and Spiegel, 1997).

Another criticism of the hedonic price index method is the extensive dataset required to implement the method. The implementation of the method requires an extensive dataset of house price observations together with the details on the physical and locational attributes of the properties concerned. It is extremely difficult and expensive, in terms of finance, time and other resources to collect a suitable dataset that will allow sufficiently robust hedonic model estimation suitable for the purpose of constructing house price indices (Leishman and Watkins, 2002).

The Repeat Sales Method

One of the criticisms of the hedonic method is that it is difficult to collect all the information about the physical and locational characteristics of a transacted house. Omitted variable bias may therefore affect the results. The repeat-sales method avoids this problem by confining the analysis to properties which have been sold at least twice in the sample (Bailey et al., 1963). Each of the observations of the dataset describes the transaction price of the first and the second sale, and the transaction dates, for a given house. Assuming the physical state of the house remain the same between the sales and the implicit prices do not change, then the witnessed house price change can be assumed to be due wholly to constant quality price appreciation or depreciation. The method does not rely on the inclusion of physical and locational attribute variables in the regression equation in estimating the Constant-quality price indices.

The repeat-sales method is a variant of the hedonic method with the only difference that the hedonic characteristics are excluded because they are assumed to be the same between the time periods (Costello and Watkins, 2002).

There are two basic variation of the repeat-sales method. These are the original repeat-sales (ORS) model proposed by Bailey et al. (1963) and the weighted repeat sales (WRS) model proposed by Case and Shiller (1987, 1989).

The original repeat-sales (ORS) model

This model regresses the ratio of the logarithm of the second sale price to the first sale price on a set of dummy variables corresponding with the time periods using the OLS estimation to get the index. The model uses only properties that have been sold at least twice over the study period.

The value for the first time dummy variable is usually represented by zero and so the cumulative price index therefore starts from 100 in the first time period.

Case and Shiller (1987) note that the influence of varying holding periods between transactions can cause heteroskedasticity. This is the case because the holding periods are not usually uniformly distributed through the sample period for the repeat-sales data. As Costello and Watkins (2002) note, normally, short holding periods are under-represented in the beginning and end periods of the index and this will induce heteroskedasticity by affecting the second moments of the regression disturbances. Case and Shiller (1987, 1989) propose the weighted repeat-sales method as a way of dealing with the heteroskedasticity problem associated with the original repeat-sales model.

The weighted repeat-sales (WRS) model

This weighted repeat sales method takes into account the fact that house prices would normally increase over time, which induces heteroskedasticity into the model. Following Case and Shiller (1989), assume that the log price of the nth house at time t, Conscious effort must be taken when using properties that involve more than two transactions over the sample period. As Palmquist (1982) notes, when there are more than two transactions for each property and all possible pairs of transactions are included in the model, the error covariance matrix is nondiagonal and must be corrected. When there are three transactions for a given property for instance, only two of the three sets of pairs are independent. These are the pairs that involve the first and the second transactions, and the second and third transactions. The pair that consists of the first and the third transactions is not independent of the other two. In the same way, when there are four transactions for a given property, only three out of the possible six pairs are independent. These are the pairs involving the first and the second transactions, the second and the third transactions, and the third and the fourth transactions. The pairs consisting of the first and the third transactions, the first and the fourth transactions, and the second and the fourth transactions are not independent of the previous three pairs (Bourassa et al., 2006). To avoid the problem of nondiagonals matrix of the error covariance therefore, only independent pairs of transactions should be used.

Another variant of the repeat-sales method is proposed by Palmquist (1980). Palmquist's model uses the ORS model. However, the ratios of the first and second sales prices are adjusted for the depreciation in period between the sales using the depreciation estimate from a hedonic result. He employs only the repeat-sales sample of data and so the data requirement is the same as the ORS model.

Another improvement to the original repeat-sales model apart from the weighted repeat sales method by Case and Shiller (1989) is the hedonic repeated model developed by Shiller (1993). This method makes it possible to account for potential changes in house characteristics between the first and the second sales. In doing this, some hedonic characteristics are included in the traditional repeat sales model. This method is advocated by Clapp and Giaccotto (1998), who use assessed values at the time of the first and second sales as a way of controlling for the quality of properties.

Advantages and disadvantages of the repeat-sales index method

Given the fact that the physical and locational attributes are not required in the estimation of the repeat-sales method, data is relatively easy and inexpensive to collect when employing the method. Indeed, the only essential data required for each property to be used for the repeat-sales index construction are the initial sale price and sale date, property identity, as well as the subsequent sale price and sale date. Also, the omitted variable bias problem associated with the hedonic regression method due to the possible exclusion of important hedonic variables is absent in the repeat-sales method since such variables are not needed in the repeat-sales estimation. However, when the implicit prices change over time and the simple or original repeat sales model is used, then the method will be biased since the ORS does not control for this. One major problem associated with using the repeat sales method in the construction of price indices is sample selection bias. The repeat-sales method may be susceptible to the characteristics of the sample of housing repeat-sales transactions used to estimate the index numbers for the population as a whole. According to Clapp and Giaccotto (1992a), datasets comprising only repeat-sale transactions are likely to be over-represented by frequently traded properties. It is normally the case that 'starter homes' which are relatively cheaper, sell more frequently due to the fact that younger homeowners usually upgrade more frequently. Also, the sample normally used to construct repeat-sales indices do not include 'brand' new constructions. This is the case because by its definition, a brand new building cannot be a repeat-sale unless it has probably been on-sold at completion (Costello and Watkins, 2002). Due to the influence of 'starter' homes and 'brand' new properties in repeat-sale samples, the sample selection biases in repeat sales can be either positive or negative. The repeat-sales indices are also based on relatively small samples as compared to the hedonic regression indices. This is because the fraction of properties that are sold more than once in a sample is very likely to be small. For example, Mark and Goldberg (1984) find 40% of repeats over a 22-year period. Abraham and Schauman (1991) find 2.5% of repeats over a 19-year interval. The repeat sales data as a sample of all transactions is only 8% in Case and Shiller (1989) who use a sample period of over 16 years. Case and Quigley (1991) mention that the sample size of repeats whose characteristics are unchanged is 33% in Palmquist's study; 4% in Case and Shiller's study in Atlanta and Chicago, 3% in Dallas and 7% in San Francisco. Clapp and Giaccotto (1992a) also note that, as many as 97% of housing transactions are to be deleted if only instances of repeat-sales are to be considered in their study. These findings clearly show smaller sample sizes with repeat-sales methods. Furthermore, the repeat sales method does not explicitly take account of the influence of depreciation on house prices. In using the method, it is assumed that no physical changes have occurred to a house between successive sales. Even if this is the case, the fact is that every house will have aged to some extent between the sales and so indices constructed with the repeat-sales may understate house price appreciation (Clapp and

Giaccotto, 1992a). Such indices can therefore be thought of as near constant-quality house price indices but not constant-quality due to the age effect between the sales (Leishman andWatkins, 2002).

The Hybrid Method

The hybrid method is another quality-adjusted house price index construction method. The study of Case and Quigley (1991) is one of the earliest studies that propose the hybrid method. The method works by combining elements of the hedonic and the repeat-sales method to estimate the index. With this method, all the transaction data, both single and repeat-sales, are used to estimate the indices and so unlike the repeat-sales, the sample size of the hybrid method is relatively large. Also, the inclusion of the physical and locational property characteristics to the repeat-sales method to estimate the hybrid method, allows for the influence of depreciation on housing transaction prices to be estimated. Other variations of the Case and Quigley's (CQ-hybrid) model include the Quigley (Q-hybrid) model, the Hill, Knight and Sirmans (HKS-hybrid) model, and the Englund, Quigley and Redfearn (EQR-hybrid) model.

The Case and Quigley (CQ-hybrid) model

One of the earliest studies of the hybrid approach is the study by Case and Quigley (1991). The authors use three stacked equations that are applied to three different groups of transaction data. The first equation is a hedonic equation that is applied to all single sales. Case and Quigley (1991) note that the Equations 2.19, 2.20 and 2.21 provide alternative methods for estimating the parameters, and consistent estimates can actually be obtained from any of the three samples as long as the samples are random. However, if information is available for two or more samples, then the relevant equations can be estimated more efficiently by imposing the appropriate cross equation constraints. Mathematically, the three stacked equations is represented by Equation

The Quigley (Q-hybrid) model

One short-coming of the Case and Quigley's methodology is that it does not model the error structure (Quigley, 1995; Hill et al., 1997). Quigley (1995) makes an improvement to the above hybrid model by basing his estimation method upon an explicit error structure that assumes a random walk in housing prices. Quigley (1995) relies upon robust GLS models to achieve asymptotic efficiency. This model combines samples of single and multiple sales in a single regression.

The Englund, Quigley and Redfearn (EQR-hybrid) model

Englund et al. (1998) also provide a variation of the above hybrid models by distinguishing between the effects of observable and unobservable aspects of quality and between the effects of "depreciation" and "vintage"3 on property prices.

Advantages and disadvantages of the hybrid method

Like the hedonic method, the hybrid method corrects for the effects of heterogeneity of properties by taking the characteristics of the properties into consideration. The method also combines both single and multiple sales and not just multiple sales of the same property. The problem of small sample size inherent in the repeat sales method is therefore reduced. Again, when only the repeat sample is used, because age and time between sales are perfectly collinear (Hill et al., 1997), it is not possible to isolate the effect of depreciation. When only single transactions of the hedonic model are employed too, serial correlation will be unobservable. Combining the two datasets to construct indices using the hybrid method therefore overcome these shortcomings. One clear disadvantage of using the hybrid method, like the case of the hedonic method, is the extensive dataset required to implement the method. The implementation of the method requires an extensive dataset of house price observations together with the details on the physical and locational attributes of the properties concerned. In addition to the extreme difficulty involved in collecting a suitable dataset, the repeat-sale sample will have to be identified and paired before the method can be used, making it more time consuming. The hybrid method requires complex econometric models and some technical econometric skills for its implementation. This reduces the confidence level people have in using the method since they cannot be sure if they have followed the right processes.

Comparison of the Index Methods Based on Previous Empirical Findings

There is a volume of literature that debates and tests empirically the relative merits and demerits of the various methods of constructing constant quality house price indices. This section reports some of the findings from these studies and compares the various index methods based on the findings. Table 2.4 summaries some of the recent studies about house price index construction. Mark and Goldberg (1984) find the repeat sales indices to exhibit smaller increases as compared to the mean and the hedonic indices. Case, Pollakowski and Wachter (1991) also find the repeat sales indices to increase more slowly than those constructed using other methods. They also do not find any clear efficiency gains from using the hybrid method. Employing data from the Kahala neighbourhood in Hawaii, USA, Case and Quigley (1991) compare their hybrid method with the ETV hedonic and the original repeat-sales methods and find that their hybrid method outperforms the hedonic and the repeat-sales methods. They do this by comparing the confidence intervals of the various methods and find the confidence interval of their hybrid method to be much narrower than the other methods. Case et al. (1991) test indices constructed by the hedonic, the repeat-sales and the hybrid methods; and conclude that the hybrid method is sensitive to the inclusion of observations in which there have been physical changes to the house between sales. They find the hedonic method to produce more robust indices. Gatzlaff and Ling (1994) also find that house price changes computed from median, hedonic, and repeat-sales indices are highly correlated at the annual frequency, but not at the quarterly frequency. The standard repeat-sales index is particularly found to be below the hedonic indices, but a repeat sales index adjusted for depreciation is not. One notion about the repeat-sales index is that it does understate house price inflation. Empirically however, the findings do not provide conclusive results about this notion. Mark and Goldberg (1984) and Case et al. (1991) find that their repeat-sales indices predict lower than expected house price growth. Clapp and Giaccotto (1992a) also find that the prices and assessed values of properties that sell twice are about 15% lesser than those of properties that sell only once. However, Crone and Voith (1992), Gatzlaff and Ling (1994) and Bourassa et al. (2006) do not find this to be the case. Hill et al. (1997) also employ data in the USA to compare their hybrid method with that of Case and Quigley (1991), the hedonic method and the repeat sales method. They find their hybrid model based on maximum likelihood method to produce the lowest mean squared error (MSE) of the price index. This is followed by the Case and Quigley's hybrid and the hedonic methods. The Case and Quigley's method however outperforms the hedonic method only when the serial correlation is large. The repeat sales method is found to be the worst estimator of all the methods. The study by Meese and Wallace (1997) suggests that the hedonic method is better than the repeat sales and the hybrid methods for the construction of property price indices. They also find the hybrid method to overstate house price inflation in respect of their sample. The repeat sales method is found to be sensitive to small samples and so the repeat sales indices suffer from sample selection bias. Englund et al. (1999) also employ a very rich transaction data in three regions in Sweden namely, Stockholm, Gothenburg and Malmö to test the effect of temporal aggregation on house price index methods using the WRS and the EQR-hybrid models. They find the EQR-hybrid method to outperform the WRS in all the three regions. Leishman and Watkins (2002) also compare the ORS and the WRS in four cities in Scotland, UK, namely Aberdeen, Dundee, Edinburgh and Glasgow at quarterly frequency levels and find that indices estimated with the ORS method are more accurate than the WRS method. They define accuracy to be the standard deviation of log index divided by the mean standard error of the regression coefficients of the time dummy variables, and indicate that the higher the ratio is for a particular index, the more accurate that particular index is. They find the ratio for the ORS indices to be consistently higher than that of the WRS indices. Perhaps, the holding periods between their transactions do not vary much and so heteroskedasticity is not likely to be a problem. Therefore, using the OLS will obviously be the best linear unbiased estimator (BLUE). In terms of house price index revision, Clapp and Giaccotto (1999) find the revisions in the repeat sales indices to be large, systematic and insensitive to the sample size. Clapham et al. (2006) find the average revision in the repeat-sales index to be -1.7%. This finding confirms the results of Clapp and Giaccotto (1999) that revisions in repeat-sales indices are downward. Clapham et al. (2006) also note that the hedonic index constructed with time dummy variables exhibit a downward average revision. However, the magnitude of the revision is lesser than that of the repeat sales, -1.0%. The authors also find the strictly cross-sectional Fisher Ideal hedonic price index, which is a geometric average of the Laspeyres and Paasche indices, to exhibit an average upward revision of 0.6%. This is the case possibly due to the fact that the sample of houses added to the previous dataset is of higher quality. It is clear from this section that none of the index methods consistently outperform the others in terms of their accuracies. Apart from the fact that differences in characteristics of the different study areas used for these studies can cause this inconsistency, two other possible reasons for this inconsistency are (i) absence of appropriate proxy for the unobservable "true" house price trend to measure index accuracy (ii) scarcity and pooling of data together across time (temporal aggregation). Some recent studies on house price index construction methods Authors and year Data period Study area Frequency Index method(s) used Result of publication

Case and Quigley 1980-1987 Kahala, Hawaii, USA Annual ETV hedonic, original repeat-sales The hybrid method outperforms both the (1991) and hybrid methods hedonic and repeat-sales methods

Hill, Knight and 1985-1990 Baton Rouge, Annual Hedonic equations, Repeat-sales The hybrid method outperforms the

Sirmans(1997) Louisiana, USA equations, and hybrid equations rest of the methods

Meese and Wallace 1970-1988 Oakland and Fremont, Quarterly repeat sales, hedonic, hybrid The hedonic method outperforms

(1997) California, USA and median sales price the rest. Repeat sales suffer from sample selection bias

Clapp and Giaccotto 1981-1991 Fairfax county, Quarterly Original repeat-sales & The hedonic repeat sale is superior

(1998) Virginia, USA hedonic repeat model to the BMN repeat-sales

Englund, Quigley 1981-1993 Sweden Quarterly Hybrid method they find their method to be able

and Redfearn to investigate price dynamics at (1998) the level of individual house sales

Englund, Quigley 1981-1993 Gothenburg, Malmö, Monthly, Quarterly WRS and hybrid method Indices produce by the finest disaggregation

and Redfearn and Stockholm, Semi-annually, and of time is better. In terms of accuracy, the

(1999) (all in Sweden) Annually hybrid method dominates the WRS method

Costello and 1988-2000 Perth, Australia Quarterly Hedonic and WRS methods The hedonic method is slightly superior to

Watkins (2002) the WRS method

Leishman and 1983-1999 Aberdeen, Dundee, Quarterly Original repeat-sales and the Indices estimated with the BMN repeat-sales

Watkins (2002) Edinburgh and Glasgow WRS methods method are more robust than the WRS

(all in Scotland, UK) method

Bourassa, Hoesli 1989-1996 Auckland region, Semi-annually Repeat-sales methods, ETV and In terms of constant-quality, the SPAR

and Sun (2006) Wellington city and the SCS hedonic methods and the method outperforms the hedonic methods

Christchurch city SPAR method and produces constant-quality indices (all in New Zealand) similar to the repeat-sales indices.

Wilhelmsson (2009) 2000-2007 Stockholm in Sweden Monthly The ETV hedonic method He finds the method to produce constant quality indices and also finds that seasonality affects house prices in Stockholm.

Measuring of index accuracies

The notional "house price trend" is not observed and so there is no specific benchmark against which the relative accuracy of the various price indices can be compared. In the absence of an unobservable "true" price trend, the average price has often been used by researchers as a proxy for the unobservable "true" house price (see, for example, Wang and Zorn, 1997; Leishman and Watkins, 2002). The use of the average price as a proxy for the unobservable "true" house price is contrary to the voluminous literature which argues against the application of the average method since it ignores changes in the mix of houses sold over time (see Section 2.4). Therefore, using the average price to represent the "true" unobservable house price can cause inconsistencies when comparing the relative accuracy of the various index construction methods. One other framework that researchers have adopted which does not require a benchmark index is to directly compare the goodness-of-fit statistics reported by the various models under investigation (see, for example, Case and Szymanoski, 1995). However, there is evidence which suggests that the goodness-of-fit statistics are misleading especially in cases where price index methods are estimated at high temporal frequencies; and for the repeat-sales method, the criteria overestimate the true reliability of the model (Sommervoll, 2006). Using this criterion to assess the accuracy of the various methods is therefore misleading and questionable and can cause inconsistencies. The problem of a benchmark or basis of comparing the accuracy of various index methods therefore remain largely unresolved in the literature. This thesis uses an application of out-of-sample forecast evaluation to compare the accuracy of the various methods based on their mean squared errors (MSE) in Chapter 4. The MSE technique is not new and is used by Hill et al. (1997) to compare various index methods based on some simulation techniques. However, instead of the complex simulation techniques, this thesis uses a relatively simplier but effective technique called an out-of-sample forecast technique. This technique involves setting aside a random subset of the sample during the estimation stage, so that the subset that is set aside can be used to predict the "true" observed sale price. In this case, both the predicted price and the true price are available for the analysis. This analysis is done in Chapter 4.

Temporal aggregation

Apart from the fact that there is no appropriate proxy for the unobservable "true" house price based on which the various house price index construction methods can be compared, one other reason why no index construction method is consistently superior to the other is scarcity and pooling of data. Real estate properties are transacted on daily basis. However, properties that are typically sold in a day are very few and infrequent (Englund et al., 1999), as compared to other financial assets like the stocks. As a result, studies that rely on transaction data often find it necessary to pool data together across time so that the sparse dataset problem could be overcome. Pooling data together across time to overcome the problem of small sample size however, involves an implicit assumption that indices generated from broader aggregated samples are statistically the same as those generated from less aggregated constituent subsamples. For example when housing transactions are combined to construct a quarterly index, it is assumed that a house transaction in January has occurred at the same time as one in March. Similarly, a house transaction in January is assumed to have occurred at the same time as ones in June and December when constructing semi-annual and annual indices respectively. To estimate a quarterly index therefore, the monthly coefficients are restricted to be equal within the quarter. That is, the quarterly price function is assumed to remain constant through January, February, and March and then jumps to a different value for April, May, and June. Because demand and supply relationship in the housing markets vary over time, this assumption is questionable. Temporal aggregation may bring about data aggregation bias in the construction of house price indices and returns (Calhoun et al., 1995). Englund et al. (1999) find that indices produced at the finest aggregated levels produce an F-ratio lower than the more aggregated once, and that the estimation of price indices at broader levels of temporal aggregation, such as semi-annual and annual levels is generally unwarranted. From Table 2.4, it seems most empirical studies are conducted using the quarterly frequency interval to compare the various methods.

Even though broader level of data aggregation is not an effective solution to the small sample size problem, at the finest levels of temporal disaggregation, the sample size may be reduced to the extent that it can no longer be able to support the degrees of freedom required for reliable parameter estimation (Schwann, 1998). The decision to choose the level of aggregation should therefore be considered as a trade-off between the problem of small sample size and data aggregation bias in the estimation of indices, and the methods used in the index estimation should ultimately make the decision since some methods are more robust when applied to small sample sizes (Schwann, 1998; Sommervoll, 2006). The issue of temporal aggregation is also re-visited and empirically examined in Chapter 4.

3. MATERIALS AND METHOD

Data Analysis

Analysis of data using index number that is using price index. An index number which is always expressed in terms of base of 100, is statistical device used to measure changes price, quantity or value of a group of related items over a period of time. In order to bring in the idea of time, the following standard convention is used;

P_o, Q_o, V_o for price, quantity or value at base time point.

P_n, Q_n, V_n for price, quantity or value at some other time point.

In selecting the base period for a particular index, two rules should be should be observed:

1. The period selected should as much as possible be one of economic normalcy or stability –relative stability.
2. The base period should be recent so that comparison will not unduly affected by changing technology, product, quantity etc in recent period.

Construction/Types of Price Indices

Index Relatives or Simple Index Number,

An idea relative is the same given to an index number which measures the changes in a distinct commodity that is,

$$\text{l}p = \frac{p_n}{p_0} \times 100 \qquad 1$$

$$\text{lq}= \frac{Q_n}{Q_0} \times 100 \qquad 2$$

Where I_p = Index price.

Where P_n= Price at some other time point.

Where P_o= Price at base time point.

And also,

Where I_q = Index quantity.

Where q_n = quantity at some other time point.

Where q_o = quantity at base time point.

But for simple aggregate index that is when we have more than item, and then we make use of simple aggregate index, that is,

$$\text{SAI} = \frac{\sum P_n}{\sum P_0} \times 100 \qquad 3$$

Where $\sum Pn = sum\ of\ price\ at\ other\ time.$

$\sum Po = sum\ of\ price\ at\ base\ time\ point.$

Remarks

It is observed from the data collected for this research work that quantity of both the apartment and building material was not given in order to compare change I price of the commodities given in the data.

Simple aggregate index number is employ to calculate the price index of different commodities for the period of 2004 – 2013. Using Gaa Akambi(A), Gaa Akambi(B) and Tanke area as a case study.

Table 1. *(Prices) of House Rent in Naira (#) Within Tanke Area Per (#)*

Year	2 Bedroom Flat	3 Bedroom Flat	3 Bedroom Bungalow	4 Bedroom Bungalow	Self Contain	Total
2004	36	60	100	120	24	340
2005	36	60	100	120	24	340
2006	60	80	120	150	24	434
2007	60	80	120	150	36	446
2008	72	96	150	150	50	518
2009	72	96	150	200	50	568
2010	96	120	150	200	60	626
2011	96	120	180	200	60	656
2012	120	150	180	250	80	780
2013	120	150	200	250	80	800

Source: Afolayan Estate Valuer; Ilorin.

To determine the price index for these varieties of building for the period of (2004-2013) using (2013=100) base year.

Simple aggregate index (SAI) is given as,

SAI = $\frac{\sum PN}{\sum Po} \times 100$

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Where P_n = For price value at some other time point.

P_o = For price value at base time point.

SAI 2004 = $340 \div 800 \times 100 = 42.5\%$

SAI 2005 =$340 \div 800 \times = 42.5\%$

SAI 2006 = $434 \div 800 \times 100 = 54.3\%$

SAI 2007 = $446 \div 800 \times 100 = 55.8\%$

SAI 2008 = $518 \div 800 \times 100 = 67.8\%$

SAI 2009 = $568 \div 800 \times 100 = 71\%$

SAI 2010 = $626 \div 800 \times 100 = 78.3\%$

SAI 2011 = $656 \div 800 \times 100 = 82\%$

SAI 2012 = $780 \div 800 \times 100 = 97.5\%$

Table 2. *(Prices) Of House Rent Within Gaa Akanbi (B) Per Naira(#)*

Year	1 Bedroom Flat	2 Bedroom Flat	3 bedroom Flat	4 Bedroom bungalow	5 Bedroom Bungalow	5 Bedroom Duplex	Duplex	Total
2004	84	96	120	150	200	250	500	1,400
2005	84	96	120	150	200	250	500	1,400
2006	96	120	150	200	250	300	500	1,616
2007	96	120	150	200	250	300	600	1,716
2008	120	150	250	300	300	350	600	2,070
2009	120	200	250	300	300	400	800	2,370
2010	150	250	300	350	400	350	800	2,600
2011	150	250	300	350	450	500	800	2,800
2012	180	300	350	400	500	600	1000	3,330
2013	180	350	400	500	500	600	1000	3,330

Source: Afolayan Estate Valuer; Ilorin.

Using the same aggregate index that is SAI $\sum$Pn$\div \sum po \times 100$, using 2013 (base year)

SAI 2004 = $1400 \div 3330 \times 100 = 42.04\%$

SAI 2005 = $1400 \div 3330 \times 100 = 42.04\%$

SAI 2006 = $1616 \div 3330 \times 100 = 48.53\%$

SAI 2007 = $1716 \div 3330 \times 100 = 51.53\%$

SAI 2008 = $2070 \div 3330 \times 100 = 62.16\%$

SAI 2009 = $2370 \div 3330 \times 100 = 71.17\%$

SAI 2010 = $2600 \div 3330 \times 100 = 78.08\%$

SAI 2011 = $2800 \div 3330 \times 100 = 84.08\%$

SAI 2012 = $3330 \div 3330 \times 100 = 100\%$

SAI 2013 = $3330 \div 3330 \times 100 = 100\%$

Table 3. *(Prices) of House Rent Within Gaa Akanbi (A) Per Naira(#)*

Year	1Bedroom Flat	2 Bedroom Flat	3 Bedroom Bungalow	4 Bedroom Bungalow	Room by Room	Total
2004	48	60	80	100	3.6	291.6
2005	48	60	80	100	3.6	291.6
2006	60	96	120	150	4.8	430.8
2007	60	96	120	150	4.8	430.8
2008	96	96	120	150	6	468
2009	96	120	150	200	1.6	572
2010	120	120	180	200	18	638
2011	120	150	180	200	18	668
2012	150	200	200	250	24	824
2013	150	200	200	250	24	825

Source: Afolayan Estate Valuer; Ilorin.

Using the same simple aggregate index that is SAI = $\sum Pn \div \sum Po \times 100$, using 2013 = 100 (base year).

SAI 2004 = $291.6 \div 825 \times 100 = 35.35\%$

SAI 2005 = $291.6 \div 825 \times 100 = 35.35\%$

SAI 2006 = $430.8 \div 825 \times 100 = 52.22\%$

SAI 2007 = $430 \div 825 \times 100 = 52.12\%$

SAI 2008 = $468 \div 825 \times 100 = 56.73\%$

SAI 2009 = $572 \div 825 \times 100 = 69.33\%$

SAI 2010 = $638 \div 825 \times 100 = 77.33\%$

SAI 2011 = $668 \div 825 \times 100 = 80.97\%$

SAI 2012 = $824 \div 825 \times 100 = 99.88\%$

SAI 2013 = 100

Table 4. *Building Material*

Year	Cement (#)	Block 9 (#)	Block 6 (#)	Total (#)
2004	790	47	42	879
2005	850	57	47	954
2006	890	67	57	1,014
2007	950	77	67	1,094
2008	1080	85	75	1,240
2009	1040	90	80	1,210
2010	1100	95	85	1,280
2011	1150	100	90	1,340
2012	1200	120	100	1,420
2013	1400	120	110	1,630
2014	1600	130	120	1,850

Source: Oladipo Block Industry, Ilorin

Using the same simple aggregate index that is SAI = $\sum Pn \div \sum Po \times 100$, using 2004 as base year.

2004 = 100

SAI 2005 = $954 \div 879 \times 100 = 108.53\%$

SAI 2006 = $1014 \div 879 \times 100 = 115.36\%$

SAI 2007 = $1094 \div 879 \times 100 = 124.46\%$

SAI 2008 = $1240 \div 879 \times 100 = 141.07\%$

SAI 2009 = $1210 \div 879 \times 100 = 137.66\%$

SAI 2010 = $1280 \div 879 \times 1002145.63\%$

SAI 2011 = $1340 \div 879 \times 100 = 152.45\%$

SAI 2012 = $1420 \div 879 \times 100 = 161.55\%$

SAI 2013 = $1630 \div 879 \times 100 = 185.44\%$

SAI 2014 = $1850 \div 879 \times 100 = 210.47\%$

Summary of Analysis

Approximated To Whole Percentage

Table 5.

Year	G.A(A)%	G.A(B)%	TANKE%	B.M.C	Increase for B.M.C
2004	36	42	43	100	0%
2005	36	42	43	109	9%
2006	52	49	54	115	15%
2007	52	52	56	125	25%
2008	57	62	68	141	41%
2009	69	71	71	138	38%
2010	77	78	78	146	46%
2011	81	84	82	153	53%
2012	100	100	98	162	62%
2013	100	100	100	185	85%

4. Discussion of Result

It is observed that the data collected for average rental value of residential properties within Gaa Akanbi (A) in table 3, and Gaa Akanbi (B) in table 2 and within the Tanke area, Ilorin per annum. The data are thousands, in which only price of item is been given, no quantity is given for the said commodity, Therefore simple aggregate index is used for this research.

Also under the rules for selecting base year in calculation of price index, the period selected should be recent, so that comparison will not be unduly affected by changing technology, product, quantity etc that is recent period should be use as base year.

Any value we get in the calculation of price index, if greater than 100%, the additional value of that was above 100% is the percentage increase in price of the commodity since the reference period. Also if less than 100%, it means it has percentage decrease in price since the reference period.

G.A (A)

Summary table 5 shows that 2004 and 2005 has 64% decrease that is as at 2004 and 2005 the price then is 64% lower than the current price. Also 2006 and 2007 has 48% decrease then the current price of 2008, 2009, 2010, 2012 has 43%, 315, 23%, 19% and 0% decrease respectively to that of current price.

G.A (B)

This area shows that 58% decrease compare to the current price for 2004 and 2005 respectively. 2006 to 2011 has 51%, 38%, 29%, 22% and 16% decrease respectively, that is the price then is better than that of current price. While 2012 is equal to 100% which means both 2012 and 2013 has the same price.

Tanke Area

The same goes for the average rental value for residential properties in Tanke area. 2004-2012 has 57%, 57%, 46%, 44%, 32%, 29%, 22%, 18% and 2% decrease respectively compare with current price. Base on the cost of building materials, 2014 was use for base year in order to determine the percentage increase in respective of whether there is change in technology, products, quantity etc.

So using 2004 as base year, it was determined that 2005-2013 has 9%, 15%, 25%, 41%, 38%, 46%, 53%, 62% and 85% increase compare with the price since the reference period.

5. Conclusion and Recommendation

We conclude that:

1. The previous year has percentage decrease compare with current year which implies that the price is increasing for the rental value of residential properties within Gaa Akanbi (A) , Gaa Akanbi (B) and Tanke area of Ilorin Kwara state.
2. Also the price of building material has some percentage increase every year which in turn correlate with the increase in value of properties.

We recommend that:

1. The pattern of building item should be analysed from time to time in order to avoid the scarcity of building.
2. The government should find a way of establishing more building industries especially cement plant to avoid the building scarcity.
3. The working class should plan ahead to have their own housing in order to avoid problem of house scarcity.

References

BAILEY, M. J., MUTH, R. F. and NOURSE, H. O. (1963). A regression method for real estate price index construction, *The American Statistical Association* **58**, pp. 933–942.

BOURASSA, S. C., HOESLI, M. and SUN, J. (2006). A simple alternative house price index method, *Journal of Housing Economics* **15**, pp. 80–97.

CASE, K. E. and SHILLER, R. J. (1987). Prices of single-family homes since 1970: new indexes for four cities, *New England Economic Review, Sep* , pp. 45–56.

CASE, K. E. and SHILLER, R. J. (1989). The efficiency of the market for single-family homes, *American Economic Association* **79**, pp. 125–137.

CLAPP, J. M. and GIACCOTTO, C. (1992b). Estimating price trends for residential property: a comparison of repeat sales and assessed value methods, *Journal of Real Estate Finance and Economics* **5**, pp. 357–374.

COSTELLO, G. and WATKINS, C. (2002). Towards a System of Local House Price Indexes, *Housing Studies* **17**, pp. 857–873.

GATZLAFF, D. H. and HAURIN, D. R. (1997). Sample selection bias and repeat-sales index estimates, *Journal of Real Estate Finance and Economics* **14**, pp. 33–50.

GOETZMANN, W. N. and SPIEGEL, M. (1997). A spatial model of housing returns and neighbourhood substitutability, *Journal of Real Estate Finance and Economics* **14**, pp. 11–31.

QUIGLEY, J. M. (1995). A simple hybrid model for estimating real estate price indexes, *Journal of Housing Economics* **4**, pp. 1–12.

LEISHMAN, C. and WATKINS, C. (2002). Estimating local repeat sales house price indices for British cities, *Journal of Property Investment and Finance* **20**, pp. 36–58.

MEESE, R. A. andWALLACE, N. E. (1997). The construction of residential housing price indices: a comparison of repeat-sales, hedonic-regression, and hybrid approaches, *Journal of Real Estate Finance and Economics* **14**, pp. 51–73.

MARK, J. H. and GOLDBERG, M. A. (1984). Alternative housing price indices: An evaluation, *AREUEA* **19**, pp. 259–269.

PALMQUIST, R. B. (1982). Measuring environmental effects on property values without hedonic regressions, *Journal of Urban Economics* **11**, pp. 333–347.

Chance, W.A. “A Note on the Origins of Index Numbers“, *The Review of Economics and Statistics*, Vol. 48, No. 1. (Feb., 1966), pp. 108–10.

Diewert, W.E. Chapter 5: “Index Numbers” in *Essays in Index Number Theory*. eds

W.E. Diewert and A.O. Nakamura (1993). Vol 1. Elsevier Science Publishers.

Ostwald, P.F., (2001). Construction Cost Analysis and Estimating, Prentice Hall International Series In Civil Engineering and Engineering Mechanics, New Jersey.

Park, W.R., (1973). “Cost Engineering Analysis”, Wiley, New York.

Pintelon, L. and Geeroms, K., (1997). “Computational model for a Belgian chemical engineering plant cost index”, Int. J. Production Economics, 49, 101-115.

Remer, D.S., Huynh, L., Agarwal, K., Auchard, B.J. and Heaps-Nelson, T., (1998). “A compilation of inflation and location indexes”, Int. J. Production Economics, 54, 41-55.

Remer, D.S. and Mattos F.B., (2003). “Cost and scale-up factors, international inflation indexes and location factors”, Int. J. Production Economics, 84, 1-16.

SSI Turkey (State Statistics Institute Turkey), (2002). Fiyat Endeksleri ve Enflasyon, Sorularla _statistikler Dizisi 2.

Turvey Demon, **(2005).** Last Updated June 6, 2005, “Price Indices” http://www.turvey. demon.co.uk/ Construction%20Price%20Indexes.doc, last access June 9, 2005.

Wang, C.H. and Mei, Y.H., (1998). “Model for forecasting construction cost indices in Taiwan”, Construction Management and Economics, 16, 147-157. Wilmot, C.G. and Cheng, G., 2003. “Estimating Future Highway Construction Costs”, Journal of Construction Engineering and Management, ASCE, Vol. 129, No. 3, 272-279.

Cran, J., (1976). Cost indices. Eng. Process Econom., 1: 13-23. EUROSTAT, Luxembourg, Industrial Trends: National Methods, Supp. December 1995

EUROSTAT (1996), Luxembourg, Methodological Aspects of Construction Price Indices.

Grogan, T., (1994). “Cost history: indexes hit by high lumber prices”, Eng. News Record 28, 46.

Monthly Labor Rev., (1995). U.S. Department of Labor, Bureau of Labor Statistics, vol. 118(4) April.

Ostwald, P.F., (1992). “Engineering Cost Estimating. 3rd ed. Prentice-Hall Englewood Cliffs”, NJ, p.170.