**New Quality Adjusted Price Indexes for Nonresidential Structures**

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## Introduction

Accurate, quality adjusted prices for nonresidential structures are necessary for a good understanding of the functioning of the economy. For example, there have been poorly measured quality improvements in many types of nonresidential structures, for such items as improved energy efficiency and pre-wiring for computer networks. In addition, better price estimates may shed light on the longstanding puzzle of low or declining productivity in the construction industry. For example, both real gross output and real value added per person engaged in the construction industry have declined in each of the three most recent years for which estimates are available. If price increases are overstated, measures of real output and productivity trends will be lowered.

In order to improve its estimates of nonresidential structures' prices, the Bureau of Economic Analysis (BEA) has developed new quality adjusted price indexes for several types of nonresidential structures. The new indexes will be incorporated into the comprehensive revision of the national income and product accounts (NIPA's) later this year. They are designed to replace the existing price index estimates, which are constructed using an indirect methodology. The new indexes are expected to be used only until the Bureau of Labor Statistics introduces Producer Price Indexes (PPIs) for nonresidential structures later in the decade. The price indexes are based on hedonic regressions, and yield rates of inflation that are slightly higher than those yielded by corresponding matched-model price index estimates based on the same source data. Also, relative to the existing price indexes, the new price indexes will slightly increase estimated rates of inflation for nonresidential structures, beginning with 1998. BEA will use the new price indexes to deflate related structure types within private nonresidential structures and Federal and state and local government gross investment in structures.

BEA's existing methodology is indirect; for the overwhelming portion of nonresidential structures, the detailed price indexes are based on a summary price index that is an unweighted average of the Census Bureau's price index for single-family houses under construction and a three-quarter moving average of the Turner Construction Company's building cost index. The use of this methodology means that movements in estimated prices of nonresidential structures are often similar to those for residential structures. Further, a previous BEA internal study of the quality of the Turner index found that it was a judgmentally-constructed index and that its documentation did not make available sufficient data to evaluate its statistical consistency and reliability. Thus, the existing methodology lacks credibility and offers no assurance that it is able to accurately portray movements in prices of nonresidential structures.

## The estimation of nonresidential structures prices

1. Earlier work on quality adjusted prices

Two approaches are generally used to estimate nonresidential structures' prices. The first approach holds quality constant by pricing and repricing sample structures that are designed to be typical of structures of a given type. The second approach uses hedonic estimates that value quality characteristics, so that the effects of changing quality can be separated from price changes. The first use of hedonic indexes for construction prices was by the Census Bureau in 1968, and was for single-family housing. A revision of the methodology for price indexes for construction was done by a joint BEA-Census Bureau group in 1974 (Bureau of Economic Analysis, 1974). Since then, with the exception of the introduction of the single-family housing price index into the calculation of price indexes for nonresidential buildings, little has changed in BEA's methodology for nonresidential structures prices.

As part of a search for an improved methodology, Edwin Coleman of BEA produced an unpublished study of the quality of 32 private sector construction cost indexes (Coleman, 1988). He found that most of the indexes contained "…one or more…conceptual or statistical problems…" He also found that the various indexes tracked reasonably closely to the corresponding NIPA price indexes for nonresidential structures. He laid out criteria for evaluating the quality of the indexes and, using these criteria, he produced standardized descriptions of each of the indexes as well as additional descriptions specific to the various indexes. He found several indexes to be somewhat more successful than the others. Among these was the Turner Construction Company's cost index, but he found that there was insufficient information to fully evaluate it. This was also the case for the Engineering News Record building and construction cost indexes that were used for Census' monthly real construction estimates. The R. S. Means Company's construction cost index made enough data available, but had some significant limitations, including changes in methodology over time.

A former BEA chief statistician, Frank de Leeuw, completed a study of construction prices in 1991 and produced two related discussion papers. The first paper used hedonic regressions with Census data and log-log specifications to estimate price indexes for multifamily housing for 1978-89, and found increases in prices that were at about the same rate as those for Census' single-family house prices (de Leeuw, 1991a). The paper also analyzed the "components" approach used by Statistics Canada for nonresidential and multifamily housing buildings. This approach specified the components of several prototype buildings and surveyed contractors to determine what they would charge for the prototypes at the time of the survey. The paper also described cyclical fluctuations in output prices relative to input prices in the Canadian construction sector.

The second paper reported on a set of hedonics-based price indexes for 1986-90 that were estimated using F. W. Dodge Company data for six types of nonresidential buildings (de Leeuw, 1991b). It noted that only a very limited set of quality characteristics were available for use as explanatory variables in hedonic regressions. Nevertheless, it found substantial differences in the trend rates of inflation for the six types of structures, and that their central tendency was similar to the published NIPA price index for nonresidential structures. It concluded that the hedonic approach did not yield significantly improved results, and that a data set with additional quality characteristics would be needed if improved hedonics-based indexes were to be constructed.

Several other preliminary studies, at both BEA and at the Census Bureau, evaluated the feasibility of developing price methodologies, both using the hedonic and the model building approaches. The studies were not continued because of a lack of resources; in particular, the necessary private information sources were too costly for either agency to afford.

The Bureau of Labor Statistics is working with a private contractor to develop PPIs for four types of nonresidential structures; warehouses, light industrial/factory buildings, office buildings, and schools. The methodology will be broadly similar in approach to the model price work that has been done in Canada. Specifications for typical versions of the structures are being developed, with some geographical disaggregation to account for differing characteristics that arise due to different climates in different parts of the country. A private source will provide estimates of the costs of materials used in construction, and sampled contractors will provide monthly updates on margins. Additional PPIs for component assemblies for nonresidential structures are being developed. The PPIs are scheduled for initial publication later in this decade. Because BEA's new indexes are designed to link up with the corresponding PPIs, the linked indexes should allow BEA to prepare an unbroken set of estimates beginning with 1998.

2. Source data

The data used to support the new price estimates are taken from annual publications by the R.S. Means Company, Square Foot Costs, and cover the period January 1, 1997 to January 1, 2003. Although this data is proprietary, it has withstood the market test of being commercially profitable over a long period of time. R.S. Means has sold its data for many years to firms in the construction business–architects, builders, and others–who use it to put together bids on construction projects. Because the Means annual cost estimates are revised in the fall of each year, the estimates are based on costs observed late in the previous year and projected forward to January 1 of the succeeding year. These costs are gathered by Means from a large number of contractors, building supply firms, and the like.

Means publishes the costs at several levels of detail. At the most detailed level, the costs for specific sub-assemblies or components are calculated as the sum of the costs of labor, materials, any equipment needed, and overhead and profit. At a more aggregate level, Means publishes estimates of the square foot costs for sample structures, both residential and nonresidential. The sample nonresidential structures are priced for 6 combinations of wall and support frame type, and for 9 sizes (in square feet). Additional information is supplied for one specimen structure of each type that describes about 34 quality characteristics, such as electrical service, types of roof, and wall finish. These quality characteristics change gradually to reflect changes in typical buildings in the

Means surveys. For example, between the mid-1990s and 2003, the type of roof changed for their sample 2-3 story college dormitory, and the electrical service was upgraded. The percent shares of each of 11 construction characteristic categories, under which the characteristics are grouped also change from year to year. For example, the share of the exterior closure category for the specimen dormitory went from 12.9 percent of the total in the mid-1990s to 14.8 percent in 2003. Site work, such as earthwork, roads, and landscaping are not included in the estimates, but architects' fees, interest costs, and taxes incurred as part of the building process are included.

At a still more aggregate level, Means estimates "city cost indexes" for 30 major U.S. cities. Nine sample structures are costed out; a 1 story factory, a 2 to 4 story office building, a retail store, a 2 to 3 story town hall, a 2 to 3 story high school, a 4 to 8 story hospital, parking garage, a 1 to 3 story apartment, and a 2 to 3 story motel. In order to simplify the computational process, the inputs to the 9 buildings are simplified and aggregated by Means, using 66 commonly used construction materials, labor hours for 21 building construction trades, the latest negotiated labor wage rates for the same construction trades, and related equipment rental costs for 6 types of construction equipment.

The 30 city cost indexes are aggregated into a national average cost index . As such, this Means index is probably not capable of picking up cyclical fluctuations other than those associated with materials inputs and labor costs. Also, the index amounts to a chained Paasche index; this is likely to understate inflation. Because the index is based on actual costs of construction, it is in principle able to pick up changes in productivity. However, as may be seen in chart 1, the Means 30-city national average price index has had broad movements in 1960-2002 similar to those of the existing NIPA price index. Year-to-year fluctuations in the two indexes also exhibit generally similar patterns, but although the Means index is about equally volatile until 1970, it is somewhat less volatile thereafter (chart 2).

Because of the limitations of the Means 30-city national average index, the Means square foot cost estimates for the sample buildings of various specifications and types offer superior information for estimating nonresidential structures prices. The blowup factors used in the calculation of the sample buildings' total costs appear to be fixed from year to year, and thus do not allow for changing profit margins.[1] A limitation of the quality adjustment process occurs because the quality characteristics of the individual sample buildings tend to change over time at a finer level of detail than that of the reported characteristics; these will not be observed at all. For example, a substitution of a more energy efficient, more costly insulation material would not be noted and would show up as a price increase. Despite these limitations, detailed price estimates based on the Means square-foot-cost data allow much more direct estimation of the prices of individual nonresidential structures types than does the present methodology. The direct estimates allow greater differentiation of prices among various types of nonresidential structures than can be obtained from the existing, indirect summary price methodology.

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[1] Some sort of cyclical corrections–perhaps along the lines of those suggested by Frank de Leeuw–might be tried, but such work is beyond the scope of this study.

3. Methodology

The hedonic price indexes underlying BEA's new nonresidential structures price indexes are "regression" price indexes. That is, ordinary least squares regressions are used to explain costs per square foot for various types of structures as functions of the number of square feet, a number of quality characteristic dummy variables, and time dummy variables that indicate the year each observation is from. The price index estimates are derived directly from the constant term and the estimated parameters of the time dummy variables.

As a check on the hedonic estimates, matched model price indexes were also calculated, using selected observations from the same data set for which more detailed characteristics information is available. Because the matched model indexes for each type of structure are based on just two observations per year rather than the 108 observations per year used for estimating the hedonic indexes, the hedonic estimates are more robust. Generally, the matched model indexes yield similar patterns of increase, with slightly lower average rates of inflation.[2] The matched model indexes are briefly described in the appendix.

Some hedonic studies of structures' prices have used structures' total costs as the dependent variables. However, examination of the Means data found that there is a nonlinear relationship between structure cost per square foot and size in square feet. Experimentation using the Means data also indicated that, for given structure type and year, the logs of these two variables have a nearly linear relationship, and limited Box-Cox testing confirmed the superiority of the log-log functional relationship Hence, the dependent variables in the regressions are the logs of the cost per square foot and the first explanatory variables are the logs of the buildings' sizes in square feet. The quality characteristic dummy variables have values of 1 when the characteristic is present and 0 otherwise, and are entered into the equation linearly. The time dummy variables have values of 1 in the indicated years and 0 otherwise and are also entered into the equations linearly. Thus, the functional form of the estimated hedonic equations is:

$$\log(\$/\text{sq. ft.}) = c + a_0 * \log(\text{ sq. ft.}) + \sum_i (a_i * \text{characteristic}_i) + \sum_t (b_t * \text{time dummy}_t),$$

where i is the set of quality characteristics, t is the set of time periods, c is the estimated constant term and the constant term and the $a_0$, $a_i$, and $b_t$ parameters are estimated coefficients.

One additional quality characteristic used in some equations is the presence or absence of basements. The cost per square foot for basements is a linear function of the number of square feet. Because the log of the cost per square foot is the functional form used for the dependent variable in the regression equations, there is a nonlinear

[2] The similarity of hedonic and matched model price estimates, made using the same or similar data, has been found elsewhere. See, e.g., Aizcorbe, Corrado, and Doms (2000) and Landefeld and Grimm (2000).

relationship between the dependent variable and the costs of basements. Also, the costs per square foot for basements have generally increased somewhat more slowly than other costs per square foot over the sample period. In order to evaluate whether this linear relationship results in distorted estimates in what is otherwise a log-log equation specification, three equations were estimated for each type of structure; an equation that combined observations on structures with and without basements and included a dummy variable for the presence or absence of basements, and two equations that each contained only the observations for structures with or without basements.

With regression-type hedonic price indexes, there is a danger that parameter instability might affect the estimated coefficients of the time dummy variables. Concerns about the sensitivity of the estimates to parameter instability led to the estimation of regressions for adjacent pairs of years for each type of structure, separately for structures with and without basements; this was done to evaluate the effects of any parameter instability. The full data set contains 648 observations for each structure type—both with and without basements—and the individual pairwise regressions are each based on 216 observations. (Half of the observations are available for the regressions for structures with, and without basements.) The results of pairwise regressions yielded price index estimates nearly identical to those yielded by equations estimated over the full, 1997-2003 sample period., and they are not described here in detail.

The types of structures for which hedonic regressions were estimated included 1 story warehouses, 1 and 3 story factories, and three height ranges for office buildings—2 to 4 stories, 5 to 10 stories, and 11 to 20 stories. Exploratory work indicated that estimated parameters of equations for structures with different numbers of stories were sometimes statistically significantly different for differing heights. As a result, separate sets of regressions were estimated for the two heights for factories, and for the three height ranges for office buildings. In addition, hedonic regressions were estimated for four types of schools; elementary, junior high, senior high, and vocational.

Reflecting the lower rates of increase for basement costs than for other structures' prices, the estimates of average rates of price increase for structures without basements were somewhat greater than those for structures with basements. Alternative estimates of rates of inflation, based on the regressions for structures both with and without basements found average rates of price increase that were between the rates for structures with, or without basements.

The estimates for the regressions combining structures with and without basements tend to weight the two variants roughly equally. In contrast, general observation suggests that some types of structures were more or less likely to have basements (e.g., unlikely for 1 story warehouses, highly likely for 11 to 20 story office buildings). Similarly, the relative importance of construction of different heights of buildings varies (e.g., more square feet of 1 story factories than 3 story factories).

As a result, the price indexes presented here are weighted averages of the separate indexes for structures of each type with, and without, basements, and where applicable, of different heights or type of school. Eight intermediate summary price indexes were constructed by weighting together the separate indexes for structures of each type with and without basements. Next, summary indexes were constructed for factories and for office buildings by weighting together the intermediate indexes for the various heights. In both stages, the weights were based on subjective judgment about the prevalence of the value of construction in each height category. Similarly, the indexes for the various types of schools were weighted together using Census Bureau estimates of numbers of students of appropriate ages, and assuming that vocational school students are one-fifth of the number of students of high school age. The two sets of weights are listed in the appendix.

There were some departures from this general methodology. The estimated rates of inflation for all four types of structures were implausibly low for 1997-98 and surprisingly high for 1999. As a result, the Means 30-city national average price index was used as an interpolator between January 1,1997 and January 1, 1999 estimates for each type and height of structure. In addition, specification changes of sample structures, combined with apparent quality changes at an unpublished finer level of detail, led to a drop in the prices of 2 to 4 story office buildings, between 2000 and 2001. As a result, a price index for 2 story medical office buildings was constructed and used for the estimate of price increase from 2000 to 2001 for 2 to 4 story office buildings. Specification changes, and apparent unpublished quality changes, for 11 to 20 story office buildings from 2000 to 2001, led to the substitution of the estimates for price increases for 5 to 10 story office buildings for the price increase for the taller buildings from 2000 to 2001.

## The estimates

### 1. Equations:

As discussed above, all of the regression equations make the log of the price per square foot a function of the log of the number of square feet. Because the dummy variables for quality characteristics–which were for exterior wall type and interior support type, two or three of the dummy variables are not used in order to avoid singular moment matrixes. Likewise, it is necessary to omit one year dummy, for 1997. Thus, the equations presented here contain 3 to 5 quality characteristic dummy variables and 5 year dummy variables.

Table 1 summarizes the estimated equations used to construct the price indexes. In all the equations, the constant term and the coefficient of the log of number of square feet are highly significant, with p-values less than .01. Likewise, the coefficients of the year dummy variables are all significant, with p-values less than .01. The time period for all of the regressions is 1997-2003.

The summary statistics for equations for warehouses, factories, and office buildings both with and without basements are very similar to those for the corresponding equations shown in table 1. The principal differences are that the combined equations had F-test statistics roughly double those for the equations in table 1. The pairwise regressions also yielded estimates for price increases that were quite similar to those derived from the table 1 equations. Alternative price index estimates, made using the pairwise regressions, found that for nearly all years, for all six structures types, the estimated rates of price change are within 0.1 percentage point of indexes estimated using the table 1 equations, and for most estimates, the rates are within 0.01 percentage point. Based on this, it appears unlikely that the effects of year-to-year parameter instability on price estimates are substantial.

Table 1.–Summary Measures for the Hedonic Regressions Used to Construct Price Indexes

| Structure type | Number of Characteristics | Number with p-values < .01 | R bar square | F-test statistic |
|---|---|---|---|---|
| Warehouses: | | | | |
| with basement | 4 | 4 | .979 | 1451 |
| without basement | 4 | 4 | .979 | 1468 |
| Factories: | | | | |
| 1-story: | | | | |
| with basement | 5 | 4 | .991 | 3364 |
| without basement | 5 | 4 | .992 | 3336 |
| 3-story: | | | | |
| with basement | 3 | 3 | .990 | 3309 |
| without basement | 3 | 3 | .981 | 3296 |
| Office buildings: | | | | |
| 2-4 story: | | | | |
| with basement | 5 | 4 | .982 | 1633 |
| without basement | 5 | 4 | .983 | 1727 |
| 5-10 story: | | | | |
| with basement | 3 | 3 | .972 | 1232 |
| without basement | 3 | 3 | .972 | 1239 |
| 11-20 story: | | | | |
| with basement | 3 | 3 | .953 | 725 |
| without basement | 3 | 3 | .953 | 729 |
| Schools: | | | | |
| Elementary | | | | |
| with basement | 3 | 3 | .997 | 13070 |
| without basement | 3 | 3 | .997 | 11824 |
| Junior high | | | | |
| with basement | 4 | 4 | .996 | 8132 |
| without basement | 4 | 4 | .996 | 7644 |
| Senior high | | | | |
| with basement | 3 | 3 | .992 | 4686 |
| without basement | 3 | 3 | .993 | 8835 |
| Vocational | | | | |
| with basement | 4 | 4 | .991 | 3519 |
| without basement | 4 | 4 | .989 | 2919 |

2. Price indexes:

The four price indexes derived from the hedonic regressions—in percent change form for the years 1998-2003—are shown in table 2. In addition, the table shows percent changes in the existing NIPA price index. (Because the new price indexes are for changes from January 1 of a given year to January 1 of the following year, the changes in the existing NIPA price index are calculated by averaging fourth and first quarter level values and then calculating percent changes.)

As may be seen in chart 3, the differences in average changes between the existing NIPA price index and the hedonic indexes are partially due to a slowing of inflation in the existing NIPA index in 2002 and 2003 that is not matched fully by the hedonic indexes. As may be seen in chart 4, the year-to-year rates of inflation for the various indexes show considerable variation. The rough similarities in pattern for the four hedonic indexes in 1998-2000 is due to the use of the Means 30-city national average price index as the interpolator between those years.

Table 2.–Percent changes in the Price Indexes

| | | Hedonic Indexes | | | |
|---|---|---|---|---|---|
| Year | Existing NIPA Index | Warehouses | Factories | Office Buildings | Schools |
| 1998 | 3.71 | 4.19 | 3.74 | 4.54 | 3.74 |
| 1999 | 3.96 | 5.08 | 4.55 | 5.49 | 4.47 |
| 2000 | 4.22 | 4.00 | 3.60 | 4.31 | 3.71 |
| 2001 | 4.45 | 3.64 | 3.89 | 4.11 | 4.50 |
| 2002 | 3.07 | 3.97 | 4.05 | 1.97 | 2.92 |
| 2003 | 1.33 | 2.52 | 4.53 | 3.17 | 3.79 |
| Average | 3.45 | 3.90 | 4.03 | 3.92 | 3.85 |

## Conclusions

The new estimates of prices for nonresidential structures introduce directly applicable quality adjustments by using hedonic estimates. Even though the new price indexes do not result in substantial changes in estimates of inflation in structures prices, they will make a significant improvement in the quality of the estimates of nonresidential structures prices. The last major overhaul of the methodology for construction prices occurred in 1974 (BEA 1974), and generally lowered estimates of inflation for the period ending in 1973. Because the lower inflation estimates led to higher trend rates of increase in real nonresidential structures investment, they helped to reduce the puzzle of low or declining productivity in the U.S. construction industry. In contrast, the new estimates of nonresidential structures prices presented here slightly raise the estimated rate of inflation, and this exacerbates the puzzle of low or declining productivity in the construction industry.

Chart 1.—Nonresidential Construction Price Indexes
(1996 = 100)

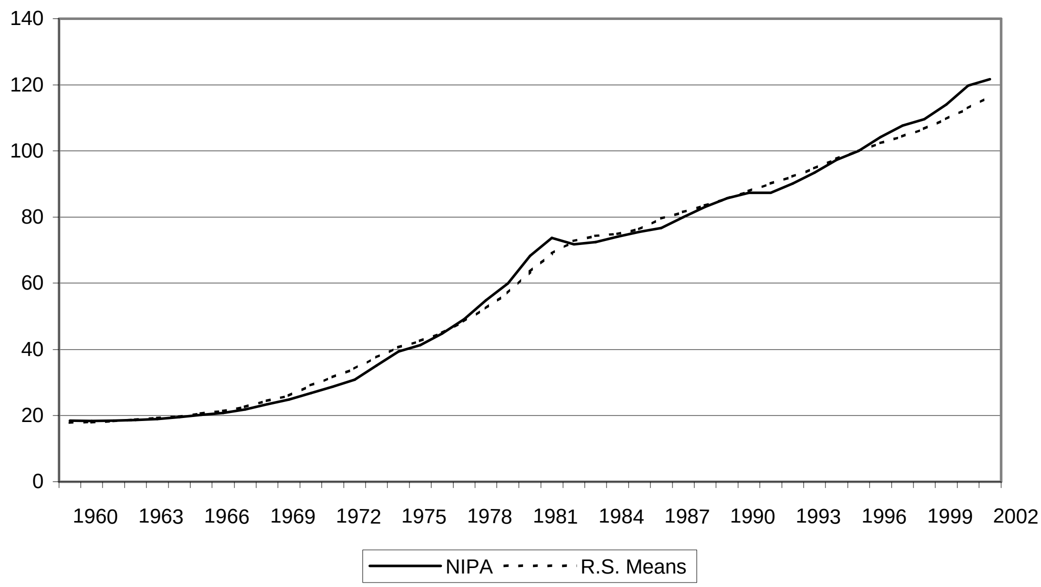


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Chart 2.—Nonresidential Construction Price Indexes
(Percent change)

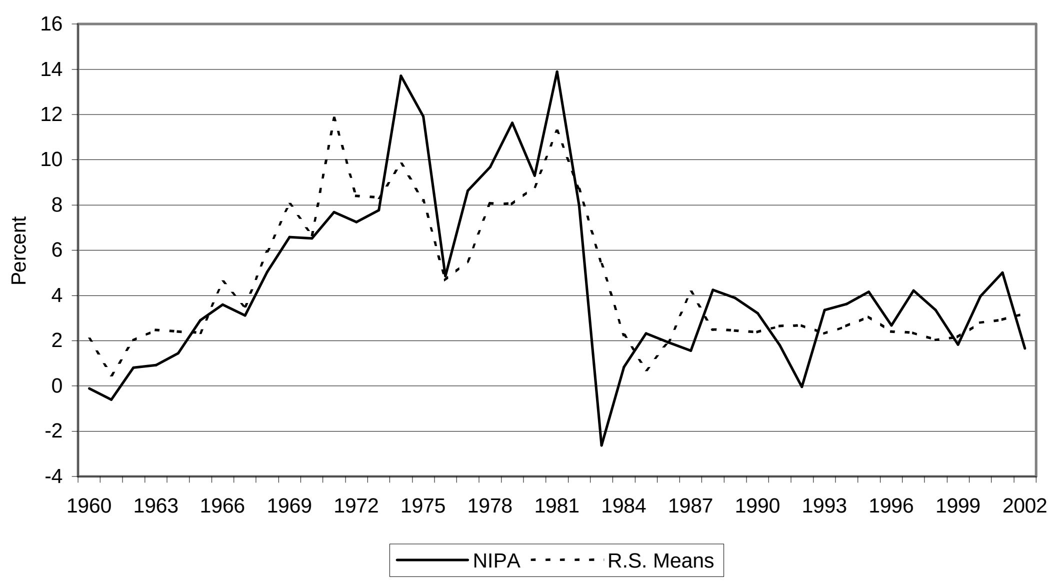


Chart 3.—Price Indexes for Some Nonresidential Structures
(January 1, 1997 = 100)

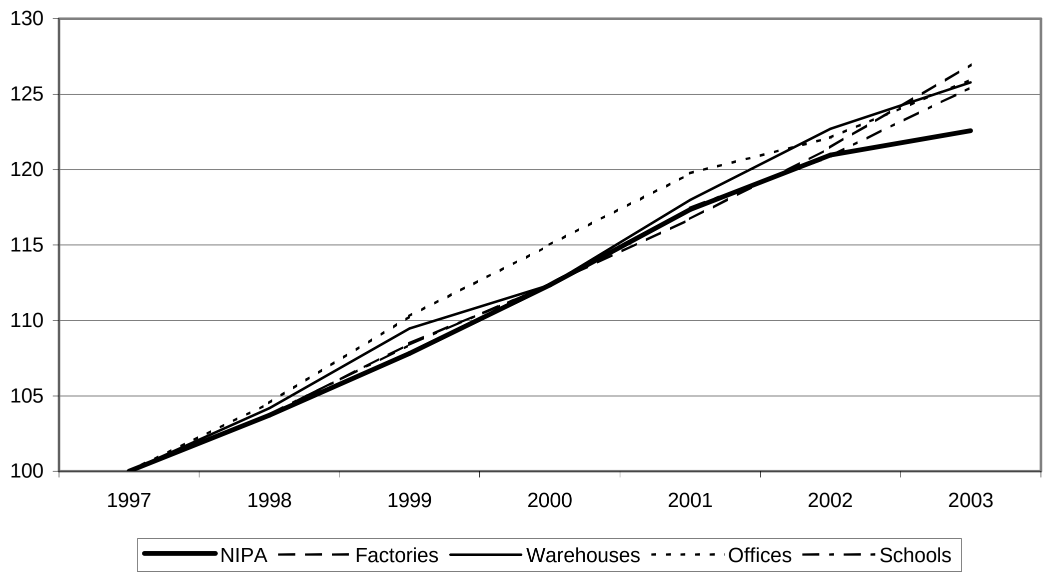
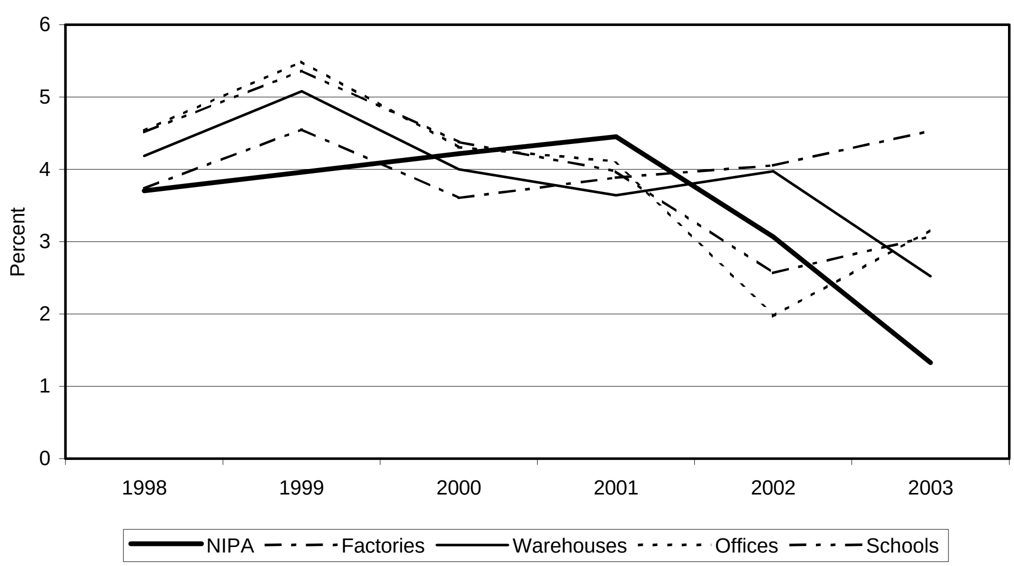



Chart 4.—Price Indexes for Some Nonresidential Structures
(Percent change)



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Appendix

1. Alternative estimates:

Average rates of increase—from January 1, 1997 to January 1, 2003—of the various quality-adjusted price indexes are shown in table A1. These include the separate hedonic indexes for each type and height of structure with and without basements (these are the detailed price index estimates underlying the estimates presented in table 2), the hedonic indexes calculated using the regressions that include structures both with and without basements, and matched model indexes corresponding to the hedonic estimates.

The hedonic price indexes increase more rapidly than the matched model price indexes for all four types of nonresidential structures, and within types, for each height class except for one-story factories. Price indexes for structures with basements increase more slowly than those without, and indexes for structures, including those both with and without basements, increase at intermediate rates. Both hedonic and matched model price indexes exhibit similar year-to-year increases, but they are not in lock step; chart A1 illustrates this for warehouse prices.

2. Weights:

The judgmental weights used to aggregate components indexes for structures with and without basements–within heights, where applicable–are shown in the first column of table A2. The judgmental weights used to aggregate different heights (or types of schools) within structure types are shown in the second column.

Chart A1.—Price Indexes for Warehouses
(Percent Change)

Table A1.–Average Rates of Increase for Nonresidential Structures Prices, January 1, 1997 to January 1, 2003

| Structure Type | Hedonic Estimates | Matched Model Estimates[1] |
|---|---|---|
| Warehouses | 3.90 | 3.86 |
| with basement | 3.63 | 3.57 |
| without basement | 3.99 | 3.95 |
| with and without basement | 3.81 | 3.86 |
| Factories | 4.03 | 4.00 |
| 1-story: | | |
| with basement | 3.48 | 3.60 |
| without basement | 4.03 | 4.12 |
| with and without basement | 3.79 | 3.90 |
| 3-story: | | |
| with basement | 4.21 | 3.97 |
| without basement | 4.40 | 4.14 |
| with and without basement | 4.31 | 4.10 |
| Office buildings | 3.92 | 3.50 |
| 2-4 story: | | |
| with basement | 3.95 | 3.43 |
| without basement | 4.09 | 3.52 |
| with and without basement | 4.02 | 3.44 |
| 5-10 story: | | |
| with basement | 3.97 | 3.71 |
| without basement | 4.03 | 3.75 |
| with and without basement | 4.00 | 3.72 |
| 11-20 story: | | |
| with basement | 3.70 | 3.42 |
| without basement | 3.74 | 3.49 |
| with and without basement | 3.68 | 3.42 |
| Schools | 3.97 | 3.77 |
| Elementary: | | |
| with basement | 3.57 | 3.43 |
| without basement | 3.88 | 3.71 |
| with and without basement | 3.72 | 3.65 |
| Junior high: | | |
| with basement | 4.05 | 3.83 |
| without basement | 4.19 | 4.10 |
| with and without basement | 4.12 | 4.05 |
| Senior high: | | |
| with basement | 3.67 | 3.42 |
| without basement | 3.78 | 3.73 |
| with and without basement | 3.75 | 3.67 |
| Vocational: | | |
| with basement | 3.32 | 3.23 |
| without basement | 3.52 | 3.46 |
| with and without basement | 3.45 | 3.41 |

1. Matched model indexes for structures with and without basements are weighted sums of the separate matched model indexes for structures with and without basements; weights are from table A2.

Table A2–Weights Within Type for Basements and Height

| Structure type | Weight within type for basements | Weight within type for height, or school type |
|---|---|---|
| Warehouses: | - - - | 1.00 |
| with basement | .25 | - - - |
| without basement | .75 | - - - |
| Factories: | | |
| 1-story: | - - - | .67 |
| with basement | .25 | - - - |
| without basement | .75 | - - - |
| 3-story: | - - - | .33 |
| with basement | .25 | - - - |
| without basement | .75 | - - - |
| Office buildings: | | |
| 2-4 story: | - - - | .60 |
| with basement | .80 | - - - |
| without basement | .20 | - - - |
| 5-10 story: | - - - | .20 |
| with basement | .90 | - - - |
| without basement | .10 | - - - |
| 11-20 story: | - - - | .20 |
| with basement | .95 | - - - |
| without basement | .05 | - - - |
| Schools: | | |
| Elementary | - - - | .54 |
| with basement | .20 | - - - |
| without basement | .80 | - - - |
| Junior high | - - - | .19 |
| with basement | .20 | - - - |
| without basement | .80 | - - - |
| Senior high | - - - | .215 |
| with basement | .20 | - - - |
| without basement | .80 | - - - |
| Vocational | - - - | .055 |
| with basement | .20 | - - - |
| without basement | .80 | - - - |