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Technical Report

Urban Land Price Indices: Austin

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Summary

Four techniques are used to identify and measure land price trends in Austin and its submarkets. The research and analysis are general and do not address specific parcels. The first technique estimates the average price changes for general property types citywide and generally defined submarkets. The other three techniques are chain indices that vary the weighting of prices and quantity of land purchased over time.

Land and price indices reveal information about the overall real estate market relative to individual parcels of property. Analysis requires specific situations to be compared and contrasted with general patterns. Evaluation of specific transactions must consider overall markets implicitly. Previously, general market pattern information was unavailable for most urban land markets. In fact, to the author's knowledge, no urban area in the country systematically collects data on land prices and develops an index of area prices.

The Austin indices are the first in a Texas urban land series to be developed by the Real Estate Center.

- Overall, Austin experienced a downward trend in both price and property sales during 1983-86.
- The combined index decline is larger than the changes indicated by a rise or drop in the average price. The average price change is similar to the time adjustment calculation used by appraisers.
- Trends of the indices vary with sections or submarkets of the city. The west and south markets were countercyclical to the overall city during the study years.

A series of studies will investigate urban and intra-urban land price changes in Texas. The first, described in this report, concerns development and interpretation of land price changes illustrated by chain indices for Austin and its submarkets.

A study of urban price changes has both general and specific applications. The general implications are:

- Realty is a major asset and measure of wealth in Texas. Therefore, knowledge of asset trends allows insights that aid economic decisions and asset management.
- Real estate activities, especially construction and housing starts, are lead indicators of overall economic activity. These activities are linked to prior land transactions. Therefore, land is not only a consumption good but also a factor of production in the development of most realty. As such, land market activity might be viewed as an early or leading indicator, a signal of economic activity during growth periods. Land activity may lag behind general economic advancement during an economic slump.
- As leading indicators, land prices and activity can suggest the growth potential of an urban economy. Understanding the land market can aid the forecasting of the direction of city growth.

The specific implications are:

- Increased knowledge of land trends can help real estate professionals and the public understand market levels in various cities and city submarkets.
- Land trends demonstrate that land markets are cyclical and volatile. Understanding this reinforces the premise that timing is strategic in real estate decisions. Recognizing patterns and trends in market activity enables individuals to determine appropriate actions.
- Urban land price trends help decision makers understand the local land market structure.

Despite the benefits derived from an investigation of urban land markets, apparently no urban area in the country systematically collects data on land prices and develops an index of area prices.[1] Therefore, a systematic process for tracking land transactions over time is being developed for Texas by the Real Estate Center at Texas A&M University.

Description of Data

The study uses 500 urban land transactions in the metropolitan area of Austin, Texas, between 1982 and 1986. During this time, an active, overheated market became a slow-to-moderate market. Other land sales data used in this study are general location, size and proposed use or zoning. Sales are standardized by using price per square foot as the basis of comparison.

Preliminary investigation began by categorizing the transactions as retail, industrial, office, single-family or multifamily residential. Analyzing and plotting the transactions by time and location reduced the categories to two general land classifications: commercial and residential.[2]

Classifying the land in two groups increased the variation observed within the submarkets. The implications of price variation as a measure of market risk will be the subject of a future technical report.

Methodology

Urban land markets over time can be analyzed with four comparative techniques. The formulas and more detailed explanations of the techniques are available in Appendix A. Only a brief description of each comparative technique is given here.

The first technique is the calculation of the change in the average price per property type for the city and each submarket. This technique is similar to the standard appraisal technique of a time adjustment. However, because overall markets rather than specific properties are being investigated, the average price of the classes of transactions is compared per period, rather than the price per period of an individual parcel.

The second technique improves on the change in average price by comparing the effect of the current year's actual transaction prices with the average of the previous year's prices. The prices from year one and year two are weighted by the quantity of land purchased in year two or the current market.[3] This index is called the *activity effect index.*[4] It weights the price changes by the current quantity of land purchased, thus reflecting the recent level of transaction when compared to the activity index from the prior year. The change in the index per period indicates activity change.

The third technique compares the average price from the current year with the actual transaction prices of the previous year. The prices from each year in this technique are weighted by the quantity of land purchased in the previous or earlier year.[5] The third method will be identified as a *price effect indicator.* It isolates the impact of the price change each year. By weighting the prices during the period by the quantity of land purchased in the previous year, the price difference for the period can be compared to the price effects from other periods. This interperiod comparison explains market expectations of growth or decline.

A comparison of the second and third techniques indicates whether the price or level of market activity is the predominate factor influencing the overall land market trend. For example, the price effect index may suggest a tremendous price rise from 1983 to 1984. However, the activity index may indicate a decline. The contrast in the direction of the two indices illustrates economic logic—if prices rise significantly, then the number of transactions may drop significantly because of reduced affordability. The object is to identify which effect dominates. At times in different submarkets, the price effect may outweigh the activity effect. At other times and locations, the activity effect may dominate.

The fourth technique involves the combined index, a quantitative measure of the

so-called "hot" index often sought by developers. It indicates potential growth areas. This index illustrates the ratio of actual prices as weighted by the quantity of activity in year two to the actual prices and quantity of transactions in the base year. This index reflects the combination of price effect and activity effect in specific submarkets. Intuitive observation of price changes and activity changes leads practitioners to perceive the market as "hot." This index will substantiate or disprove the perception. There is, however, a strong possibility of misinterpreting the combined index. Therefore, it is necessary to analyze the price and activity effects separately (see Appendix A). Losch, in critiquing Fischer's "ideal index," stated that the combined index could not be presented validly without considering the separate effects of price and activity.

The techniques used in the systematic analysis of the urban land market are not the typical price indices that might be expected for other goods. This research is not modified because of the peculiarities of real estate but because it is difficult to develop aggregate real estate databases and because of the economic instability during the study period. The traditional index is built on a base year representing 100. The base year usually represents a stable, typical or normal economic environment. At this point in the research, such a year cannot be identified with available data. As the investigation period expands and the database increases to reveal general patterns, a traditional index will be used.

Another reason for not choosing a base year now is the diversity of the data sources. Data for the various cities and submarkets cover different periods. Therefore, a geographically consistent base year is not possible to facilitate comparative analysis intitially. **The traditional indexing procedure will be considered in the future (see ULI references in the *Notes* section).**

To offset data and cross-tabulation conflicts, to enable consistency between city markets and to afford a systematic analysis of urban land patterns, the three techniques developed in this report can be called *chain indices.* They differ from traditional indices in that the base in each value calculation is the previous year and not a predetermined standard year. Also, using a year-to-year comparison facilitates comparison between the chain indices and the industry standard of an annual price change.

Given the chain effect of a year-to-year basis, comparing the four techniques identifies potential market changes and turning points. By looking at four indices, more information about past and future market activity can be gained. Market participants may be responding to one effect and not the other. For example, by emphasizing the average price change (Index 1), market players miss the volatility and activity level that identify market niches.

Price and activity level changes in the Austin urban land market (chain indices two, three and four) are illustrated in Tables 1-7 in Appendix B. These indices are compared to the annual price change. Because the average price change is a percentage, it illustrates a moderate trend compared to the magnitude shown by the chain indices. The average price change is always below the indices.

Data are presented for the overall city, city submarkets and various periods. The tables are separated into general submarkets of the metropolitan area, the year of the activity and the general property type (use). Market segments are investigated to elevate the impact of an active neighborhood on the overall price change average. The active market can distort the overall city measure to the degree that a

distressed area of the city is not identified. The chain indices also offset typical real estate shifts such as a regional mall breaking ground in a previously residential subdivision and thus rapidly increasing the neighborhood's average price. This is accomplished by dividing the indices into residential and commercial segments. However, no real estate market functions in isolation. The encroachment of a commercial facility into a residential area implies a neighborhood in transition. The transition is, in part, indicated by an increase in the price effect index and perhaps the activity and combined indices because a competition of uses is now affecting the market.

The change in the average price per square foot of land per year (column 2), the index indicating the activity effect (column 3), the index indicating the impact of the price effect (column 4) and the index that represents the combination of the two effects (column 5) are included in the tables. A description of the various indices and their strengths and weaknesses is found in Appendix A.

Two methods of analysis are represented in this report. The first is a period-to-period comparison within each market. The comparison of each index from period to period is a descriptive analysis illustrating trends and directions of change.

A second method of analysis is a comparison of the four indices. This method reveals the relationship of price changes to the volume of market activity.

The changes are explained by comparing and contrasting the indices. Explanations are based on specific economic, political and social factors within the community being studied. These explanations are useful in forecasting and interpreting similar events.

Austin Chain Indices

For brevity, the term *index* is used to mean the chain indices and the average price change index. The first set of indices investigated is for Austin's overall commercial and residential land markets. These indices illustrate the general trends of the city's land markets and will be useful in comparing Austin with the other cities in forthcoming studies. In this report, the overall indices reveal economic trends in Austin and allow the city's land submarkets to be compared with the city. The city-to-submarket comparisons help explain the city-wide economic pattern.

Commercial and Residential Trends

The general patterns in commercial land transactions are depicted in Figure 1 and Table 1. The first index depicted by a solid line is the average price change. The average price change rises from a low during 1983-84 (-25 percent) by about 20 percent during 1984-85. The average price then declines 37 percent during 1985-86.

The activity index during this same three years is fairly constant. Activity increased slightly during the 1984-85 period and the 1985-86 term shows a higher level of activity than the 1983-84 period (see Table 1 in Appendix B). Generally, the activity level does not fluctuate as radically as commonly perceived during this period.

The price effect index mirrors the average price change but is much more amplified. This suggests that the expectations of market performance exceeded actual transactions when compared with the activity index.

All three indices (average, activity and price effects) reflect the economic environment of the city's real estate market at the time. The early 1980s were good

economic times in Texas. Economic and demographic trends show much growth and a stimulated level of activity in the state. Oil and other extractive industries were profitable. The majority of the agricultural sectors were productive. The healthy economy attracted people and capital to the state, although part of this influx is attributed to a recession in the rest of the country. Texas was considered the area of opportunity, the Japan of North America. Some believed Texas to be recession-proof.

Austin experienced a high level of growth during 1982-83, much of it stimulated by economic conditions in Houston, Dallas and West Texas. Companies housed in these cities and Midland opened branches and sent capital into the Austin area. The attraction of capital from other Texas cities to Austin is unusual. Austin's economic base is government and higher education, which did not draw well prior to 1980. Therefore, much of the initial attraction is attributed to the city's physical, cultural and recreational amenities. That the initial growth stimulus is linked to amenities and not economics is important to Austin's future potential.

Historically, the draw of amenities is best illustrated by the events of 1983-84. The oil and extractive industries began to slow down and real estate people talked of a slower market. This slowdown is quantified by the negative average price changes for both commercial and residential properties. Low activity indices also reflect the slowdown. In fact, much of the slower market resulted from fewer transactions rather than price effect or expectations. This slowdown may be attributed partially to uncertainty in the oil industry and the response of Dallas and Houston decision makers to the 1982 recession.

The period of 1984-85 was active in Austin, as the price effect shows. The magnitude of the residential market price index is much higher than the commercial market (note the residential index of 7.298 versus the commercial index of 3.109). Several major employers came into the local market in 1984-85. MCC, the research consortium, Lockheed and other employers generated much speculative behavior. These expectations of more growth based on current levels of growth are illustrated by the significant difference between the price effect index and the activity index. The misinterpretation of the economic base relationships between the activities moving into Austin and their potential draw for other activities further explains the difference between the price and activity indicators and the decline depicted from 1985 to 1986.

Combined Index

The combined index illustrates the actual market. The combined index weighs the activity and price in each year compared to the previous year. When the massive price (and hence expectation) index is offset by the activity level, the decline is evident beginning in 1983-84. This is when the problems in the rest of Texas were beginning to be felt. This combined index also shows that Austin's economy was in a residual and lagging position compared to the rest of the state, specifically Dallas and Houston.

The overall indices for Austin are illustrated in Figures 1 and 2 and Table 1. Land price indices used for an entire community fail to consider the impact or weight of location on prices. To offset this problem, various Austin submarkets are investigated.

Submarket Indices

To incorporate the impact of location into the indices, six submarkets are defined. Except for the central business district (CBD) and the subdivisions in the west and northwest segments of the city, the majority of the submarkets cover large

areas (quarters of the city). The northwest and west sections are broken into smaller segments for analysis of the indices.

Central Business District

Austin's CBD is between I-35 on the east and Lamar Boulevard on the west. The southern boundary is Town Lake and the northern boundary is Martin Luther King Boulevard (MLK) (see Figure 15).

Commercial Land

The CBD experienced two active periods in the early to mid-1980s. The first stimulation to both activity and price increases came with the overall growth in the Texas economy (Figure 3). Both the activity and price effects are in step during 1982-84. After the 1984 peak, the price effect tends to dominate. The peak in the average price change and the two base effects (price and activity) in 1984 necessitate an in-depth analysis. The impact in that year is demonstrated by the rapid rise of the combined index. The year 1984 can be divided into two periods when investigating the price trends of inner-city land. The first part of the year experienced moderate growth, representing the general trend for the city as the market emerged from the slower market of 1983-84.

However, in 1984, the market responded to the city's authorization of increased density for developments in the CBD. The increase allowed expansion of maximum building height from 120 feet to 200 feet. Expectations of greater returns caused the price effect to increase greater than the activity index. Activity was limited, given the narrow market for inner-city properties and the inelastic supply of CBD land. The result is a lagging but rapid increase in the combined index. Despite the indication that price and activity slowed as early as mid-1984, the combined index shows that major CBD projects were still in motion during 1984-86, when other city land markets were beginning to slow. As with other Austin land market segments, CBD indices began to decline in 1985-86.

Residential Land

Residential land use is limited in the CBD, even when residential facilities are developed in conjunction with office and other commercial facilities such as the original Encore development or the Littlefield condominiums. However, despite the tendency for commercial uses to outbid residential uses, there is still some activity in the CBD. Much of the CBD residential land lies to the southeast along Town Lake, in the warehouse districts south of Fourth Street or in the west end of the CBD.

Residential activity has been much more stable than the commercial markets (Figure 4). The average price change, the price effect and the activity level have been relatively constant each year. The combined index showed a steady increase during 1983-85. No transaction data were available for 1985-86.

The nonexistent-to-moderate increases in housing—an active market for much of the city—can be attributed to the limited market segment seeking inner-city residence. In Austin during this period, the 18- to 34-year-old age group dominated, and the typical household size declined from 3.3 to 2.7. This decline implies a younger resident and the potential for increased multifamily demand. However, several multifamily residential projects proposed in the CBD were dropped, termed infeasible or put on hold because of the limited market. The lack of development is partially attributed to the relatively easy access to outlying residential areas. Accessibility increases the competition of traditional housing with more typical amenities than the product offered in the CBD. The demand for suburban housing compared to the limited demand for

inner-city housing and a preference for freestanding homes versus condominiums support the limited residential market illustrated by the indices.

South Land Market

The south land market is demarcated by a radian beginning south of Town Lake at the CBD and spreading out to the Hays County line. The west boundary is the area east of Lamar Boulevard and U.S. 290 West. The east boundary is a line beginning at the CBD and extending with Burleson Road south toward Onion Creek (see Figure 15).

A major difference in the perspectives of commercial and residential housing can be illustrated by the south market in Austin from 1983 to 1985. As the other areas of Austin will show, this two-year period demonstrated much growth in land market prices and activity. As Figures 5 and 6 illustrate, this was not the case for south Austin. Because of the rapid growth and extensive development, the sewer and water systems in south Austin were overtaxed. A court-ordered moratorium on new sewer attachments was put in place, effective from mid-1984 to the first quarter of 1986. The activity indicator for both residential (Figure 6) and commercial properties (Figure 5) is in decline from 1983 to 1985. The commercial activity index then levels off through 1986. No activity was indicated in 1985-86 for large residential tracts. Most of the existing land tracts were held by developers and speculators. Also, by 1985-86, the market had sufficiently dropped off, preventing entry by more developers.

Commercial Land

The price effect in the commercial market (Figure 5) is higher than and parallels the activity index pattern. This indicates moderate expectations at best. The moderate expectations are reasonable, given the active market and overall expectations of growth during the early to mid-1980s. The price effect and activity index were merging toward the 1985-86 market period. The slower market, based on the overall economy, then altered market expectations and the declining activity was originated by the moratorium and reinforced by the economic slowdown.

Residential Land

The residential market illustrated in Figure 6 suggests a more speculative relationship between the expectation level and the activity level based on the moratorium. The 1983-85 growth phase was characterized by relatively expensive residential properties. Many homebuyers expected prices to continue to rise, given the city's perceived growth. The moratorium effectively limited supply, thus forcing a premium to be paid for residences with sewer hook-ups. Whereas a business or investment property venture could be delayed to a more timely market, the residential market had people with housing problems; families whose houses were not legally habitable had no place to live (many stayed months in hotels). Several builders (most notably Nash Philips/Copus) paid to have sewage transported from the southern sewage treatment plant to a plant in north Austin. Sewage was transferred across town to enable purchasers to occupy homes in a timely fashion. As a result, price expectations remained high despite economic realities. The imminent impact of declining expectations on the local economy is depicted by comparing the rapid decline in the price effect index to the activity indicator (see Figure 6).

Combined Index

The combined indicator is fairly moderate for residential land during the 1983-85 market (see Figure 6). This moderate decline is highly influenced by the price expectations. The combined index for the

commercial market is declining more than the residential (compare Figures 5 and 6). This rapid decline can be attributed to the parallel relationship of the activity and price effect. The commercial market is expected to be less speculative, given the rational investment premise used to make the land purchase decision (a market return). Therefore, the commercial market appears to have capitalized on the general economic conditions and the lagging impact of the sewer moratorium, while the residential market may not be as efficient.

Northeast Land Market

The northeast quadrant is the land area delineated by a line extending from the CBD along East 12th Street (parallel with U.S. 290 East) on the south and I-35 on the west. The east boundary is the Manor Independent School District and the north boundary includes the Pflugerville area in Williamson County.

Overall, the northeast market of Austin has lagged in receiving the benefits of growth enjoyed by the rest of the community. Industrial development along U.S. 183 has been the major land use characterizing the area. The physical terrain does not possess the amenities of west Austin or the Hill Country. The northeast is costly to develop because of the impervious clay predominant in this area of Travis County. The initial activity in the northeast quadrant was the commercial development at the intersection of I-35 and U.S. 290.

Commercial Land

As in most of the city, the commercial activity in the northeast peaked in 1984-85. Unlike the rest of the city, the activity index has exceeded the price effect (see Figure 7). Much of the stimulus to the commercial land market in the northeast has been the high price effects in the rest of Austin. The high prices occurring during the overheated market forced many residential developers to the less expensive land in the northeast. Commercial users followed the residential development.

The limited natural amenities and the lower land prices, which have attracted affordable residential development, in part explain the high concentration of industrial users.

The weight of the moderate-to-declining price effect and the resulting regional expectations of decline despite the increasing activity effect during the 1984-85 growth years created the dramatic decline of the combined index. This combined index decline occurred despite efforts to deliver affordable housing and expectations of a new airport in the east to northeast portion of the county (see Figure 8). In part, the negative commercial activity index occurred because of the general economic decline and because the stimulating impact of the potential airport did not occur until the economy was in poor condition. At the same time, many of the available land tracts still are in speculator-developers' hands and are being held until the airport potential can be exploited appropriately.

The converging pattern of the indices in Figure 5 during 1985-86 indicates that the activity and price effects are weighted equally in the northeast so that market expectations and actual market activity are consistent.

Residential Land

The residential market in northeast Austin presents a different picture. The combined index is declining with the general economic conditions (as in the commercial market). However, the combined effect for the residential market declines during 1983-84 and 1984-85 at a greater rate than the commercial market. The price and activity indices for the residen-

tial market then rise rapidly during the supposed down market from 1985 to 1986. The change in the average price indicates the largest increase (see vertical line in Figure 8). The 146.6 percent increase is basically a rising trend from $3 per square foot to approximately $7.50. This activity in 1985-86 distorts the area's potential because the sales in the latter period are not spread throughout the market segment. The 1985-86 market is heavily weighted by transactions along I-35. An explanation of purchasers' motivations may be that they planned to extend the Well's Branch development east of I-35.

Well's Branch is a quasi-planned community development in north central Austin between Round Rock and the core of Austin. The Well's Branch location is associated with much of the high-tech and commercial development on the west side of I-35 and the land off Lamar and Burnet Road. This commercial development along with Well's Branch could push land prices upward east of I-35.

The decline in the combined index supports the contention that residential sales are weighted by transactions along I-35. The combined index is moving contrary to the patterns of both the activity and price effect, in part because the limited sales at high prices in recent transactions are offset by the magnitude of activity at lower prices during the 1983-85 period.

Northwest Land Market

The northwest market has been a major growth sector of Austin. The sector forms a triangle with the apex at the CBD and radiating out toward the northwest Hill Country. The southern portion extends the CBD because of the influence of the Capitol Complex (a concentration of the state buildings and ancillary government facilities) and the University of Texas campus. The northwest market as delineated includes the segment often called north central Austin. The east boundary is I-35, the west boundary is Lake Austin and the north boundary is the Cedar Park and Leander communities.

This market varies sufficiently in general land uses to be segmented into three rings for analysis of commercial and residential land markets. The first ring begins near the CBD at 11th and 12th Streets in the south and extends north through the university area to 29th Street.

The second ring is an inner-city fringe of older residential dwellings and encroaching commercial activity. This area is bounded by 29th Street on the south and 45th Street on the north. This area is characterized by the university and a medical facilities complex.

The third ring, the largest, comprises the entire northwest hills quadrant of Austin. This ring extends east from I-35 to Lake Austin and RR 620 in the west. The south boundary is 45th Street and the Highlands area. The northern limit is Round Rock.

First Ring—Commercial

Commercial activity in the first ring is illustrated in Figure 9A. The indices are listed in Table 5. The average price declined rapidly. It dropped from 223.7 percent in 1983-84 to 21.11 percent in 1984-85 (see Figure 5). No 1985-86 transactions were disclosed. The drop from 1983-85 can be explained by the nature of the real estate market and its development around the University of Texas. There was a great influx of students and faculty into the university in the early 1980s; this attracted entrepreneurs (mainly services such as restaurants). Market observers also witnessed numerous requests for rezoning to "O," for office and institutional facilities. These requests, in part, had to do with the inclusive progressive zoning system of Austin and the marketing of student condominiums. The condominium craze and

the expectations of growth (see the high price effect index in 1983 in Figure 9A) forced up commercial prices.

The commercial market also reflected expectations in 1983-84 that declined in 1985 because office buildings expanded into the area west of the Capitol Complex. Much of this development can be attributed to a single entity, United Bank.

The price, activity and combined indices indicate that the first ring of the northwest market peaked in 1984 and declined during 1985-86.

First Ring—Residential Land

The northern extension of the CBD and the university area can be characterized best by the residential market. Market activity in this area was heavily dominated by student condo development. The market was so active during this period that it received media attention in cities such as New York and Tulsa, Oklahoma. The market catalyst was selling a life-style as well as real estate. This market was stimulated further by the tax laws in effect from 1981 to 1986. The 1981-84 tax acts allowed for rapid and large depreciation write-offs. The market also was encouraged by expectations of high appreciation or the potential for good rental returns or both.

The perceived demand drove requests for rezoning to office or "O." Office zoning allowed the highest density of residential development per acre. In 1983-84, this land use forced other uses to bid higher prices. The student condo market was the first sector of the local real estate market to be saturated.

Unfortunately, the perceived market was linked directly to the growth in university enrollment. However, only 2 percent of the student body came from families that could afford the 1981-83 interest rates of 14-18 percent and the $100-per-square-foot price. The constant level of the price effect and the activity indicator illustrate the limited market (see Figure 10A). The two indices are depicted as intertwined. The weighted effect of the price and activity measures is indicated by the combined index, depicted as a straight decline for 1983-85 (see Figure 10A).

Second Ring—Commercial Land

The second ring of commercial land transactions in the northwest sector is depicted by a constant level of activity and price effect during the period of investigation. As illustrated in Figure 9B, there is a tendency for convergence of the two to affect indices in 1985-86. The convergence reveals a constant level of expectations for growth in the area, given the price effect pattern and a moderate increase in the activity.

The combined index illustrates a peak in 1984-85 in commercial transactions and a decline during the 1985-86 term. The convergence of a level price effect and a slowly increasing activity effect results in a declining combined index. This could indicate that the activity in the area is for maintenance service and is not actual growth.

The transactions in this section basically involve commercial facilities to be used as services to the university population and medical office and ancillary service establishments. The structures in the second ring are older and fairly built up. Commercial raw land transactions are limited.

Second Ring—Residential Land

This area is built up with residences constructed from the 1920s to the 1960s. No major residential developments have been constructed in this area. There has been sporadic in-filling of single-family residences and some small apartment and condominium projects.

Activity picked up in 1984-85 and

exceeded the price effect toward the end of the year (see Figure 10B). This relationship can be explained by a belief that this sector has the potential to be another Tarrytown. These expectations are based on the overheated 1982-84 market. The decline in expectations depicted by the constant price effect index has a greater impact than the moderate activity increase. The interaction of these effects shows a significant decline in the combined index. No transactions could be verified for the 1985-86 market.

Third Ring—Commercial Land

The third ring of Austin's northwest quadrant was one of the hot spots in commercial land activity (see Figure 10C). This sector includes the U.S. 183 corridor, the northwest MoPac area, the north end of Loop 360 (Capital of Texas Highway) and the RR 620 developments. As in the overall city, the market peaked in 1984-85 (see Figure 9C). The activity index in this area closely parallels the price effect index. The activity index approaches the price index at its peak, the pattern expected in an active but normal market. The expectations of future appreciation should lead the actual activity, generating more activity if the basic economics of the sites are supported by economically rational land uses and associations. The activity and price effects should intersect or be tangent at the peak and the leader-follower relationship should continue in the decline. Despite the closeness of the two indices, the excess price effect compared to the activity effect suggests the expectation for appreciation.

The rapid decline of the combined index after the peak period illustrates the importance of market growth expectations. During a down period, buyers' actions indicate more than their expectations. The decline of the combined index is supported by the oversupply of commercial facilities along U.S. 183 and its major intersections (MoPac, 360 and 620).

Much of the stimulation to the northwest to north central commercial land market came with the announcement of MCC, IBM expansion and other high-tech industrial activity. The expectation of value enhancement by construction of 360 and the extension of MoPac attracted commercial land buyers to the area.

As the indices suggest, the linkage and economic relationships in this area are adequate to support the land activity. The difference experienced between the price effect and the activity effect is not as great as the variation in many other areas. The small deviation implies a lower level of speculation than a large difference would indicate.

Third Ring—Residential Land

The northwest also was a major growth area for residential land transactions. The commercial activity was, in part, pulled along by the expectations of residential development. The residential development in turn was drawn by the number of employment centers in the north section of Austin and the amenities of the Hill Country.

However, as the indices illustrate when Figure 10C is compared with Figure 9C, the residential market was more speculative than the commercial market. This measure of speculation, in part, may imply that the expected benefits derived from hills, trees and other natural amenities are overpriced. Overall, these amenities rate a higher price in residential purchases than commercial purchases. The prices in the area also were influenced by the moratorium placed on developments in south Austin. Figure 10C depicts a much more accented price effect in relation to the fairly constant activity indicator. The stability of the activity indicator might suggest that an identifiable user market for

residential land in north Austin can be delineated.

The broad difference between the price effect and the activity index shows that northwest residential land (and hence housing) is overpriced. Purchasers' expectations greatly exceed market actions. The weight of the low activity index relative to the price effect (declining in the 1985-86 period), pulls the combined index into decline. The drop in expectations further accentuates the decline of the combined index.

Residential markets in the northwest were further hurt by a market preference for and the marketing of the Eanes School District. This preference is best identified in the period of decline indicated by the combined index (see Figure 13B).

Southeast Land Market

The southeast segment of the Austin land market is delineated by a line extending northeast from the CBD along East 12th Street toward Decker Lake Road. The line runs parallel to U.S. 290 (see boundary description of northeast land market). The west boundary is a line extending south to southeast from the CBD in the direction and along the axis of Burleson Road. The east and south borders are the respective county lines.

Commercial Land Market

The southeast market did not experience the degree of growth that the overall city experienced during 1983-84. It suffered as did the south Austin market because of the sewer moratorium. The slower growth and the wet, unstable soil of the southeast market contributed to land being priced relatively low, given the expansive economic phase of 1983-84. However, increasing prices and activity are observed during the 1984-86 market (see Figure 11). Prices and activity increases can be linked to various factors. In general, land was relatively inexpensive compared to other locations in the city, so that the index depicted an increase based on a low starting point. The area also was recognized to be in close proximity to the CBD (compared to the northwest and southwest markets). It also is recognized as a neighborhood of land uses for growth activities that are land extensive (see 1985-86 period in Figure 11). The growth activities were generated by employers in high-tech, research and development and industrial warehousing. Specifically, Lockheed located in the southeast during the period of increasing price and activity indices. Trammell Crow completed South Park during this time. Advanced Micro Data also moved into permanent facilities. The microchip industry had a moderate upswing in 1985-86 compared to the prior year, in which many high-tech personnel were working four-day weeks.

Despite the active economic impact of the high-tech industries, however, the combined activity and price effect indices depict a decline during the 1985-86 market. The contrast between the increasing price and activity indices and the declining combined index is illustrated in Figure 11 and supported in Table 6.

Residential Land Market

The residential land market in southeast Austin lags the overall market, in part because of the sewer moratorium and because of the relative affordability of housing compared to the rest of the community. As illustrated in Figure 12, the activity index peaked in 1984-85 as evidenced in many neighborhoods in north and west Austin. The price effect, however, declined from 1983 to 1985 and then increased from 1985 to 1986. The increasing expectations can be linked to the relatively lower pricing of housing in this sector compared to the remainder of the city and the termination of the sewer moratorium. Also, the increase in employment

facilities contributed to the increasing price expectations in the southeast market.

The combined index for residential land is directly opposite the commercial land market. The price effect greatly overpowers the activity level, suggesting that the latter period transaction illustrates high expectations of appreciation for properties in southeast Austin. This increase in the price and combined indices is greatly influenced by the market actions in the land between Austin and Bastrop (see Figure 12 and Table 6).

West Land Market

The final submarket of Austin has been an area of strong growth. The west to southwest market trailed the northwest quadrant until early 1985. The southwest quadrant of Austin is located in the area defined by a line extending west from the CBD south of 12th Street toward the shore of Lake Austin. The north boundary then runs along the south side of Lake Austin westerly to RR 620. The east to south boundary of the west market is along Shoal Creek to Lamar Boulevard, south to U.S. 290 West.

As with other growth areas, it is necessary to divide the west market into separate rings extending out from the CBD. Three commercial and residential rings are identified.

First Ring—Commercial and Residential Markets

The first ring is small enough to consider both commercial and residential indices simultaneously. This ring is an isolated built-up area limited in growth potential by natural boundaries. The east boundary is the CBD. The south boundary is Town Lake (Colorado River) and the west border is Lake Austin (Colorado River). The north boundary is the residential agglomerate of Tarrytown. Included in this neighborhood is University of Texas land bequeathed by the Brackenridge estate. The university land is used for student housing, botanical research and a golf course. The golf course is possibly a mixed-use development site; which dominates any future private market potential. Use of nonuniversity land may change with the development of the university estates, but at best will only achieve ancillary economic status. The market has been limited in this area, depicting activity characteristic of the hot market of 1984-85. There was some activity in the 1982-83 market, with expectations of westward CBD expansion between Lamar Street and MoPac. The commercial activity west of MoPac has been minor at best.

The limited activity is depicted in Figure 13A by a bar graph. The land market is limited in this area because it has long been built up. The university controls the bulk of all undeveloped land. Activity was not sufficient for a linear graphing of the indices. The activity in this area exceeded the price effect, representing the limited expectations of appreciation. Appreciation expectations can be linked to the status of CBD expansion to the west or the development decisions for the university land. The weighted impact of the price expectations on the activity index is illustrated by the low combined index.

The residential land activity is lower than the commercial index number but relatively higher than the residential price effect (see Figure 14A). As the bar graph illustrates, the activity has been relatively high because of a close location at low prices. The relatively low price effect for residential markets is .716276, illustrating a decline during the 1984-85 period (see Table 7). The declining price effect has a greater influence on the combined index than the activity measure. This suggests that expectations of appreciation for the area are not emphasized in market transactions.

Second Ring—Commercial Land Market

The second land ring southwest of the CBD includes the growth areas of the Eanes School District. The area comprises the communities of Rollingwood, Westlake Hills and Barton Creek. After the opening of Barton Square Mall in 1981-82, the commercial development in this area increased dramatically. This segment of Austin, although one of the most environmentally sensitive and subject to intense political and neighborhood association involvement, has shown a steady increase in both the activity and price effects of transactions. The expectations for the market, as indicated by the price effect, have exceeded the activity index. (See Figure 13B and Table 7.) The excess expectations via pricing over activity have pulled the combined index down to a slow decline in depicting the 1985-86 market. This decline is attributed mechanically to the growing excess of price effect over activity. The more accurate interpretation of these effects is that the rapid price increase has eliminated many people from the southwest market despite a strong city-wide preference for the Eanes School District.

The overall city preference is for residences in the southwest market; however, the residential demand has attracted commercial growth. Commercial land activity also has increased since 1982-83 because of the improved roads such as Loop 360 and the bridge over Lake Austin, the extensions of MoPac, William Cannon Drive and Boston Lane. The cumulative effect has been to make the southwest more accessible to the rest of the city. Improved accessibility induced employers such as Motorola to move into the area. Residential and employment growth has increased the service activities to the west. The high incomes of the residents have been a major inducement for commercial activity.

Second Ring—Residential Market

Residential sales were available for 1982-83 for the second ring of the southwest quadrant. In 1982, an active market benefitted from the strong oil trade in the early 1980s (see Figure 14B). The southwest residential market declined just as the overall city experienced a slowdown with the general Texas economy. However, as the indices show, the price effect during 1983-84 declines at a slower rate than the activity index. The decline in activity or quantity purchases contributes to the downward slope of the combined index during the perceived hot market of 1984-85. While the combined index is dropping, both the price effect and the activity index are increasing. The price effect greatly outpaces the activity measure, suggesting that the area is becoming overpriced for many residential consumers at the same time that the buyers expect further appreciation. Activity picked up in the area during the 1985-86 market. This was a declining market period for the rest of the Austin submarkets and the city. The increased activity corresponds with a decline in expectations as reflected by the price effect. Despite the expectation of decline, which must be linked to the economy of the city, the activity increase was sufficient to cause a major upturn in the combined index.

This rise in the southwest market, contrary to the general city pattern, is explained partially by recognizing that land prices represent the consumption of a composite (if not complex) good. Alonso segmented the land into two general goods—land and location.[6] In southwest Austin, location is a catch-all concept and specifically means the school district. The high price paid in the Eanes School

District can be attributed to easy accessibility to the CBD, the amenities of terrain (Hill Country) affording both urban and natural landscape views, and quality education. The Eanes School District has ranked high consistently in state surveys on education, often first or second in the state on academic issues (after Highland Park in Dallas). It is also separate from the Austin Independent School District and is not subject to busing out of the general neighborhood. The result is that the west is the preferred area of Austin for those who can afford it. Therefore, the indices illustrate marketing preferences as a result of factors other than land and the marketing bias of agents as well as buyers. See Figure 14B and Table 7B for the countercyclical trends.

Third Ring—Residential Market

The third ring of the west to southwest Austin land market is the area west of Loop 360 (Capital of Texas Highway) and south of Lake Austin (see Figure 14C). The market segment then extends north towards FM 2222 and west to Lake Travis. This section includes several school districts and supports the previous analysis. The school districts included are Austin, Leander, Lake Travis and Eanes. The impact of considering the combination of school districts in the location variable of the land price is that prices in this subsection of the west-to-southwest land market have increased over time (even into the general down market) but not to the extent of the solid market illustrated in the Eanes district. Figure 14C depicts both a price and activity index increase. The price effect outstrips the activity effect and indicates increasing expectations of appreciation. However, like many of the other submarkets, the increasing variation between the price index and the activity index results in a decline in the combined index. The combined index decline suggests a lagging future decline in the overall market. Despite the increases in activity and price, the combined index illustrates a flat market for 1985-86. In this regard, the activity in the west land market mirrors the combined index for Austin.

Third Ring—Commercial Market

The commercial land market in the west submarket of Austin is limited. The indices for commercial activity in this area are only for 1985-86 (see Figure 13C and Table 7). Commercial activity has been more recent than in many other sections of Austin. The timing of the commercial activity is attributed to two factors. First, the area's growth has been recent and there was not sufficient residential density to support much commercial development (in terms of employment or retail or service markets). Second, the intense environmental regulation or pending regulation is a factor. The lack of clear regulation creates uncertainty that can impair market activity.

A negative average price change and fairly constant activity and price indices reflect this market (see Figure 13C). The consistent price and activity indices can have an upward influence on the combined index. Limited information is derived from the commercial market indices at this point. The bar chart is significant because it depicts past activity, which is often a concern in the future.

Conclusion

Urban land market research provides information for developing insights and making decisions in a market historically evaluated by intuition and experience. The job of the land economist is to reduce uncertainty in a market characterized by uncertainty and expectations. The reduction of uncertainty and the availability of information allow practitioners, buyers and sellers to make more informed choices. Informed real estate choices should create

a more efficient and equitable market, appropriately allocating available resources.

Four indices are presented to illustrate the commercial and residential land market activity in Austin, Texas, from 1983 through 1986. The indices will be updated to the current period followed by an annual and cumulative report.

During the 1983-86 term, the city-wide land market for both commercial and residential land rapidly increased, peaking in 1984-85 and then declining. These peaks and declines varied in terms of the activity or price effects so that a combined effect often is illustrated contrary to common perceptions. For example, both the price and activity indices for the city illustrate dramatic growth during 1984-85. The growth shown by both indices supports the common perception of a hot market. However, the combined index illustrates that the market began a decline during 1983-85, which, in hindsight, is a more accurate description of actual events.

Land market analysis must be linked to location. The insights developed for the overall city market can be limited in making individual real estate decisions. The delineation of submarkets provides a more accurate basis for decisions. Segmenting the land market by location and type (commercial and residential) revealed that sections of the city market contrasted with the overall market and with other segments. The south and southeast markets that were slow during the active economic period of 1983-85 because of a sewer moratorium clearly demonstrate this. The west market, which was active during the city-wide declining stage because of the preference for a school district, also shows that the city is not one market but several.

The indices are offered to help investors make informed decisions. The research and analysis are general and cannot address problems of a specific property. Such problems require a property-by-property analysis as offered by professionals such as brokers, appraisers, lenders, lawyers and developers. However, all analysis requires the ability to compare and contrast specific situations to general patterns. The evaluation of specific transactions must be based on an implicit judgment of overall markets. This series of technical reports attempts to facilitate insights into the overall market using information previously not available.

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Appendix A

Appendix A
Indices of Analysis

Four indices are developed to aid the analysis of urban land trends. This appendix addresses the nature and development of those indices.

Index One

Index One is the average price percentage change (per square foot). It is similar to the market change or time adjustment used by an appraiser in that it compares the difference between the price in period two to the price in period one as a percentage of the period one price. The formula is as follows:

$$\frac{\bar{P}^2 - \bar{P}^1}{\bar{P}^1} = \text{Average Percentage Price Change}$$

Where:

$\bar{P}^1$ = Average price in period one

$\bar{P}^2$ = Average price in period two

The difference between this time adjustment and those used by appraisers on individual properties is that it is not the comparison of a sale that occurred twice within a specified period but a comparison of market averages from one period to another.

The problem with reliance on the comparison of averages is that averaging tends to smooth major fluctuations in the market over time. The smoothing process may mislead readers into believing that change between periods is not traumatic, when in fact it is. To offset this possibility, additional indices are developed.

Index Two

The second index is called the activity index. It is based on the Paasche index but altered for real estate in two aspects. The formula for the traditional Paasche index (PI) as altered for real estate is:[7]

$$PI = \frac{\sum_{i=1}^{n} p^2Q^2}{\sum \bar{p}^1Q^2}$$

The superscripts in the Paasche index (as well as the Laspeyre and Fischer indices) are actually subscripts representing the year of the price and quantity, and not the square of the parameter. The symbolism used is traditional. However, the traditional model must be altered for a real estate application.

The first alteration used in this model is that the divisor must rely on the average price from period one because the same properties are not sold in both periods one and two. The use of an average price in one period or another is necessary because of the heterogeneous nature of land transactions. Although it can be argued that vacant land as space to house economic activity is a fungible good,[8] each parcel can still be considered unique. The second aspect considered for real estate application is that much of urban land's economic uniqueness is its location or situation within the city.[9,10,11] The situation can change from parcel to parcel. Therefore, a specific parcel cannot be weighted by a nonexistent price (if it did not sell in both periods). The property in one period or another can only be weighted by the expected price. In this study, the expected price is the average price indicated by the market (as is the established process in the majority of estimation models). The location concern is addressed by the segmenting of the overall city data. The importance of the inclusion of location in the model is discussed in more detail later.

The second index is used as an activity index because it is weighted by the quantity of land purchased in the second

period (current). The volume of the quantity transacted in the current period can be compared to the volume transacted in the previous period to indicate a decline or increase in the quantity sold. Also, if the activity index modifies the price effect isolated in the third index, the impact of market action to expected price changes can be illustrated.

Index Three

The third index is a modified Laspeyre index. The Laspeyre index compares the difference in price between two periods by weighing the prices with the quantity transacted in the first period (the past market). In this regard the Laspeyre index can be perceived as isolating a price effect and thus market expectations of appreciation or decline. The formula of the traditional Laspeyre index (LI) as altered for real estate is:[12]

$$LI = \frac{\sum \bar{p}^2 Q^1}{\sum p^1 Q^1}$$

As with the Paasche Index and for the same reasons, the Laspeyre model has an average price substituted for the nonexistent price of the property in the second period. Segmented geographical markets also are analyzed. This index is considered to insulate the price effect because the quantity sold in the first period is used (no change in market activity). The weight of the price ratios by the previous market quantity has the effect of focusing on the price differences of the two periods and thus indicating the impact of prices in the index. Because current price is supposedly the present worth of future anticipated benefits, then the price effect can be used as a measure or estimate of market expectations.

Index Four

The fourth index is the ratio of current prices and quantities purchased to previous prices and quantities. Such an index has been attributed to Irving Fischer. It was developed to offset the weaknesses of the Paasche and Laspeyre indices.[13] The formula for the combined index (CI) is:[14]

$$CI = \frac{\sum p^2 Q^2}{\sum p^1 Q^1}$$

The combined index, as it is called in this report, was developed to offset the *Laspeyre index's tendency to be biased up* and the *Paasche index's tendency to be biased down.* As a ratio of the weighted prices and the quantity between the periods being investigated, the combined index can be identified as the indicator that either rationally reflects market perception and thus guides market decisions or it can be a real measure of market behavior distorted by the market participant's emphasis on price and volume. In either case, Losch states that to offer the combined index without its component parts (the price and activity indices) is a worse practice than to calculate the index from one of them alone.[15]

The author agrees with Losch that by calculating all four indices contained in this report, users can develop greater insight to land markets.

Losch, as a location expert, also pointed out that another problem with price indices is the failure to consider location on the measure of price changes (and thus standards of living). Many attempts at developing land price indices have suggested the use of location weightings. The basis for the weights has not been clear in the literature (or appears to be subjective).[16]

This report addresses the location problem by calculating submarket indices as well as an overall city index. The comparison of the submarkets to the city will then reveal overall market patterns. Also, it is expected that the submarket indices may better address most real estate situations. On the other hand, the overall city indices can relate to general economic concerns.

The overall objective of the urban land price indices is to apply this research to eight or more Texas cities with more than 200,000 in population.

With the expansion of these indices to other cities, general patterns of performance can be developed. After more years of data are developed, statistical time series analysis will be offered with the four indices. Currently, insufficient data are available for this service. With the expansion of the methodology, it is expected that supportable general trends in the indices will be observed. Preliminary trends observed in the applications of the indices to Austin submarkets and the overall city are identified in Table 3.

Examples of Indices Calculations

The following section illustrates the calculation of the indices and the significance of their differences.

The first index is a comparison of average percentage prices from one period to the next.

Table 1. Average Percentage Price Change

Example

1985	1986
3.50/SF	4.00
4.00	3.75
3.00	4.00
2.50	5.00
5.00	6.00

$P^1 = \$3.60$ $\quad$ $P^2 = \$4.55$

$S \pm .96$ $\quad$ $S \pm .94$

$$Pi = \sum_{i=1}^{n} \frac{P}{\bar{n}}$$

$$\text{Average percentage price change} = \frac{\bar{P}^2 - \bar{P}^1}{\bar{P}^1} = \frac{\$4.55 - 3.60}{3.60} = 26.38\%$$

Source: Real Estate Center at Texas A&M University

An alternative formula for average percentage price changes is:

$$A\% = \frac{\bar{P}^2}{\bar{P}^1} - 1 = \frac{\$4.55}{3.60} - 1 = 26.38\%$$

The average price change depicted as the ratio between the difference and the base (or 1985) price is the same as the alternative method of showing the different year's prices as a ratio less than 1 ($\bar{P}^2/\bar{P}^1$ - 1). The reason for indicating the first method is to illustrate the technique for time adjustment used by appraisers and other real estate decision makers. The second method or the ratio format is used to show the similarity between the percentage change technique of the appraiser and several economic indices. If the number one were not subtracted to get the percentage change, this index would be more in line with the standard perception of an index.

The Paasche, Laspeyre and Fischer indices introduce the weighted effect of the quantity of a commodity sold (the activity) into the measure of market change. As illustrated previously, they differ in the emphasis and timing of the activity weighting.

The impact of the quantity sold and the emphasis of timing of the quantity considered is as follows.

The Laspeyre index is represented as a measure of the price effect index in the Urban Land Market study. The price effect index weights the P^2/P^1 percentage change ratio by the quantity sold in an earlier year (given the chain method suggested in these reports). The prices and quantities of properties sold and used in the index are illustrated in Table 2. The average percentage price changes used are from Table 1.

$$PI = \frac{\bar{P}^2 Q^1}{P^1 Q^1} = \frac{\$4.55(54{,}000)}{128{,}500} = \frac{245{,}700}{128{,}500}$$

$$PI = 1.912$$

To compare the price effect index to the average percentage price change used by appraisers, the index number can be reduced by one to indicate a 91.2 percent change attributed to the price effect or difference in prices (and hence expectations of use and value) between the two periods.

Table 2. Example of Price Quantities in Indices

P1 dollars	Q1 sq. ft.	P1Q1 dollars	P2 dollars	Q2 sq. ft.	P2Q2 dollars
$3.50	7,000	$24,500	$4.00	10,000	$40,000
4.00	6,000	24,000	3.75	21,000	78,750
3.00	10,000	30,000	4.00	7,000	28,000
2.50	10,000	25,000	5.00	11,000	55,000
5.00	5,000	25,000	6.00	5,000	30,000
Total	38,000	$128,500		54,000	$231,750

Source: Real Estate Center at Texas A&M University

The Paasche or activity index considers the weighting of the quantity sold, but in this case considers the quantity in the second time period. This allows an insight to the effect of market activity in relation to the price effect indicated by the Laspeyre index (Index 3). The calculation of the activity effect index is:

$$PI = \frac{P^2 Q^2}{\bar{P}^1 Q^2} = \frac{231{,}750}{3.60\ (54{,}000)} = \frac{231{,}750}{194{,}400} = 1.1912$$

$$PI = 1.1912$$

The activity impact of 19.2 percent is moderate compared to the average percentage price change of 26.38 percent. A key concern of the activity effect index is that the impact on price is 19.2 percent even though quantity change alone indicates an increase of 42.1 percent (54,000 - 38,000 ÷ 38,000).

The market activity in relation to the price change has been moderated as measured by the third index (activity effect or Paasche index). The moderation is relative to the 91.2 percent increase identified by the price effect. Often the activity effect and price effect are working in opposite directions. The activity indication may show a decline while the price effect may be increasing (or vice versa).

The final index is a ratio of the weighted price and quantities for years one and two. The equation is:

$$PI = \frac{P^2 Q^2}{P^1 Q^2} = \frac{231{,}750}{128{,}500} = 1.803$$

The combined effect of the differences between prices weighted by the square feet sold in each period is 80.3 percent. This combined price-activity effect is three times greater than the percentage change of the average price. This difference is the result of several factors. The first is mechanical. In the average percent index, averages in both time periods are compared to actual average transaction prices in one period versus an average price in the other. The emphasis on actual and average prices varies in the price effect and activity effect indices. Therefore, comparison of these two indices contains more information than the impact of price changes in relation to activity levels. It also suggests the range of variation possible in a given market period.

The display of the price effect and activity effect indices along with the combined index enables a segmentation of the forces (or factors) reflected in the comparison of the weighted prices. Presenting all of the indices allows insights to the inverse relationship of prices and quantities.

Also, the activity and price effect indices aid in the explanation of any variation between the combined index and the average percentage price change as typically used in industry on a parcel-by-parcel basis.

Summary of Indices Patterns Based on Austin Data*

Characteristics of Indices	Average Price Change	Activity Index	Price Index	Combined Index
Amplitude of fluctuation relative to other indices and reasons	Moderate to fairly stable smoothing because of averaging	Less volatile than price and combined effect; constrained by effective demand and user markets.	Most volatile; Prices indicate future expectations.	Intermediate in volatility because of interaction of price and activity effect.
Pattern: Level	No price change	Constant quantity purchased if price is level; major decline in quantity if price increases. If price decreases, the major increase is in quantity purchased	Constant and level expectations if quantity is level; major decline in price if quantity sold increases. Major increase in price if quantity sold decreases.	Limited or no change in price and quantity; or offsetting effects of quantities and price.
Increasing	Increase in average sales price	Increase in quantity sold. The magnitude of quantity increase is dependent on price change. There is a negative association. The greater the activity change, the smaller the price change, or negative.	Increase in price. The magnitude depends on quantity sold. Negative associations: better activity and price are expected.	Increase. Magnitude of increase depends on price-quantity relationships. The comparison of patterns to price and activity effects will determine which variable is most influential on the overall index.
Decreasing	Decrease in average sales price	Decrease in quantity sold. Magnitude dependent on reciprocal association of price and quantity.	Decrease in price. Magnitude dependent on reciprocal association of price and quantity.	Decrease in both activity and price effects from previous period. Causal weight of activity versus price indicated by comparison of price and activity indices.
Pattern in normal market	DNA	Great magnitude of activity over price effect. Broad market, quantity demanded based on low prices. More current market perspective or market dominated by users.	Great magnitude of price over activity effect. Speculative market. Price changes as indicator of expectations. Depicts intermediate to longer term market perspective. May be dominated by intermediate buyers or middlemen.	Varies with the impact of activity and price effect. Activity greatest impact in stimulating market price in the long run.
Lead relationships of activity or price effects on combined index: Based on relative positions	DNA	Below, parallel or increasing at slower rate than price effect.	Declining growing at faster rate than activity effect.	Declines but with a lag**
	DNA	Identical to price and growing or level.	Identical to activity and growing or level.	Increases but with a lag**

Note: DNA = data not applicable.

*The overall nature of the indices cannot be fully generalized until studies of other cities are conducted.

**The combined index is a composite of the price and quantity effects (but with different weightings). Tracking of the indices at this point illustrates that the combined index often is contrary to the price and activity indices, even when they are moving in the same direction. The limited data suggest a lag effect. The possibility of the composite lagging tendency supports Fischer's requirement that the other indices be illustrated and analyzed also.

Source: Real Estate Center at Texas A&M University

Appendix B

Appendix B
Supplementary Tables and Figures

Table 1. Overall City of Austin Urban Land Price Indices

Year	Average Change	Activity Effect Index	Price Effect Index	Combined Index
		Commercial		
1983-84	-0.25675	0.285904	1.327507	2.22445
1984-85	0.196256	0.440307	3.109864	0.664702
1985-86	-0.36699	0.33373	1.719781	0.629845
		Residential		
1983-84	-0.21777	0.115524	4.525192	8.314656
1984-85	0.07795	0.240089	7.298982	0.404614
1985-86	-0.36776	0.139908	2.838594	0.454117

Source: Real Estate Center at Texas A&M University

Table 2. Central Business District Land Price Indices

Year	Average Change	Activity Effect	Price Effect	Combined Effect
		Commercial		
1982-83	-0.2826	0.74309	0.84161	6.48
1983-84	-0.0515	0.94064	0.9155	0.16
1984-85	0.65199	1.58292	1.66631	0.63
1984-85	0.3163	1.06427	1.37438	3.79
1985-86	-0.6254	0.38786	0.46331	0.06
1985-86	-0.6254	0.38786	0.46331	0.06
		Residential		
1883-84	0.1435	1.14357	1.14195	0.3
1984-85	0.086	1.08601	1.08601	0.99
1985-86	-	-	-	-

Source: Real Estate Center at Texas A&M University

Table 3. South Land Price Indices

Year	Average Change	Activity Effect	Price Effect	Combined Effect
		Commercial		
1983-84	1.606	2.32398	2.5884	2.85
1984-85	-0.031	0.79857	1.08637	0.67
1985-86	-0.153	0.85448	1.02841	0.63
1986-87	-	-	-	-
		Residential		
1983-84	0.626	0.95066	2.76002	2.2
1984-85	-0.402	0.407789	1.02522	1.95
1985-86	-	-	-	-

Source: Real Estate Center at Texas A&M University

Table 4. Northeast Land Prices Indices

Year	Average Change	Activity Effect	Price Effect	Combined Effect
		Commercial		
1983-84	-0.4588	0.41542	1.19505	8.086329
1984-85	0.4918	1.816975	1.606269	2.134357
1985-86	-0.3387	0.53437	0.543621	0.538094
		Residential		
1983-84	0.961538	1.126798	2.113557	5.632055
1984-85	0.0098	0.600128	1.749549	0.450977
1985-86	146.6	1.59985	4.120158	0.078224

Source: Real Estate Center at Texas A&M University

Table 5. Northwest Land Price Indices

Year	Average Change	Activity Effect	Price Effect	Combined Effect
Commercial First Ring (Census Tracts 700, 602)				
1983-84	223.7	3.028862	3.237248	1.431562
1983-84	0.0618	1.183525	1.042589	1.29901
1985-85	0.2111	1.211301	1.294639	0.48033
1985-86	----	----	----	----
1983-87	-0.1285	0.87311	0.87311	0.115626
Commercial (Determined by Development Barriers) Second Ring (Census Tracts 204, 302, 500)				
1983-84	0.411	1.078399	1.39328	0.41451
1984-85	0.0702	1.021502	1.400291	1.972478
1985-86	0.1737	1.116973	1.353626	0.543767
Commercial Third Ring (Census Tracts 201-1810)				
1983-84	-0.4961	0.815334	1.01357	1.732795
1984-85	1.33913	1.4	1.445618	1.530094
1985-86	-0.21899	0.70215	0.968017	0.04369
Residential First Ring (Census Tracts 700, 602)				
1983-84	0.1979	1.187916	1.197916	4.101162
1984-85	0.3909	1.390956	1.402666	0.373824
1985-86	----	---	----	----
Residential Second Ring (Census Tracts 204, 302, 500)				
1983-84	0.2375	1.13733	1.24746	15.568
1984-85	0.165	1.65856	1.268631	0.044395
1985-86	----	----	----	----
Residential Third Ring (Census Tracts 201-1810)				
1983-84	-0.10118	0.314971	1.699189	7.113003
1984-85	0.4374	0.455796	4.101888	0.488574
1985-86	-0.0851	0.375938	2.88487	0.482199

Source: Real Estate Center at Texas A&M University

Table 6. Southeast Land Price Indices

Year	Average Change	Activity Effect	Price Effect	Combined Effect
		Commercial		
1983-84	0.94377	0.613556	2.171818	10.2231
1984-85	-0.5162	0.295425	1.43352	0.534106
1985-86	0.92989	1.420724	3.160189	0.140728
		Residential		
1983-84	-0.124	0.340215	5.677889	11.7368
1984-85	0.31889	0.597871	3.395416	0.714257
1985-86	0.806567	0.241738	4.058643	2.054891

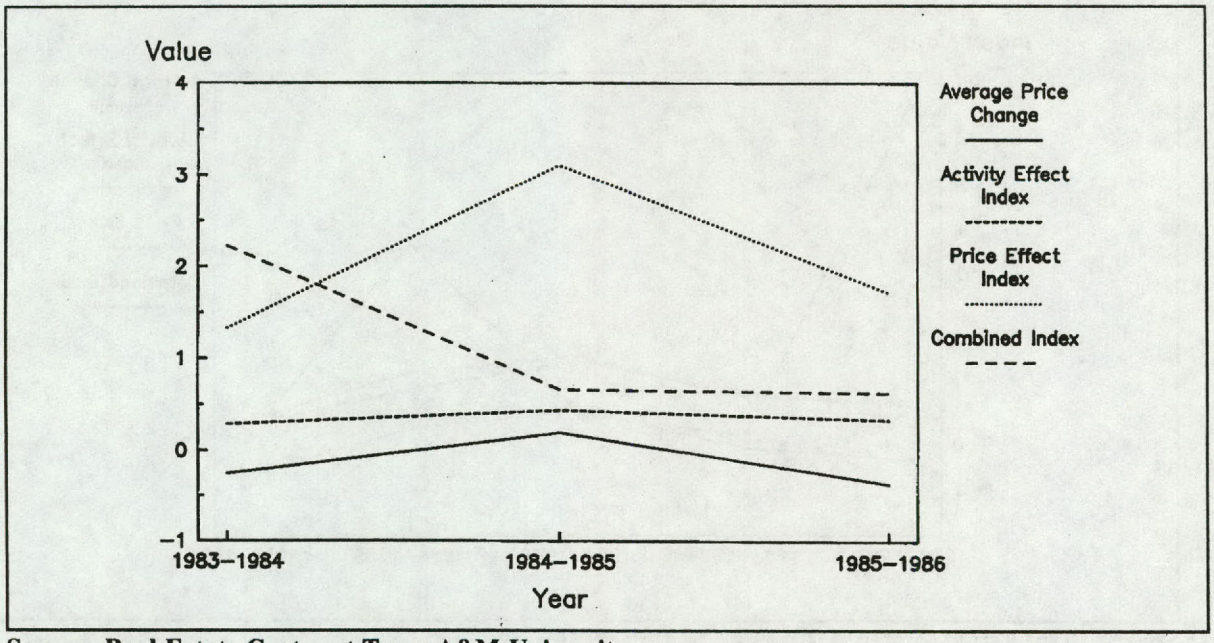
Source: Real Estate Center at Texas A&M University

Table 7. West Land Price Indices

Year	Average Change	Activity Effect	Price Effect	Combined Effect
		Commercial		
First Ring (Census Tract 1200)				
1984-85	-0.0657	0.924519	0.716276	0.080795
Second Ring (Census Tract 1901-1903-1904)				
1983-84	-0.041	0.526179	0.523252	0.295132
1984-85	0.27	1.007152	1.424613	2.968672
1985-86	0.7727	1.410246	2.236988	2.596118
Third Ring				
1985-86	-0.26433	0.732005	0.755841	0.852801
		Residential		
First Ring (Census Tract 1200)				
1985	-0.197	0.88294	0.392791	0.392791
Second Ring (Census Tract 1901-903-1904)				
1982-83	1.06896	2.0650096	2.20475	6.637713
1983-84	-0.3388	0.176063	0.659722	7.469345
1984-85	0.2521	0.862944	4.693702	0.19718
1985-86	1.1208	1.879763	3.08369	2.506476
Third Ring (Census 1711, 1715, 1717, 1902, 1703)				
1983-84	-0.599	0.14914	1.106109	14.13856
1984-85	-0.435	0.253562	1.973769	0.161072
1985-86	-0.5047	1.802584	4.501127	0.222706

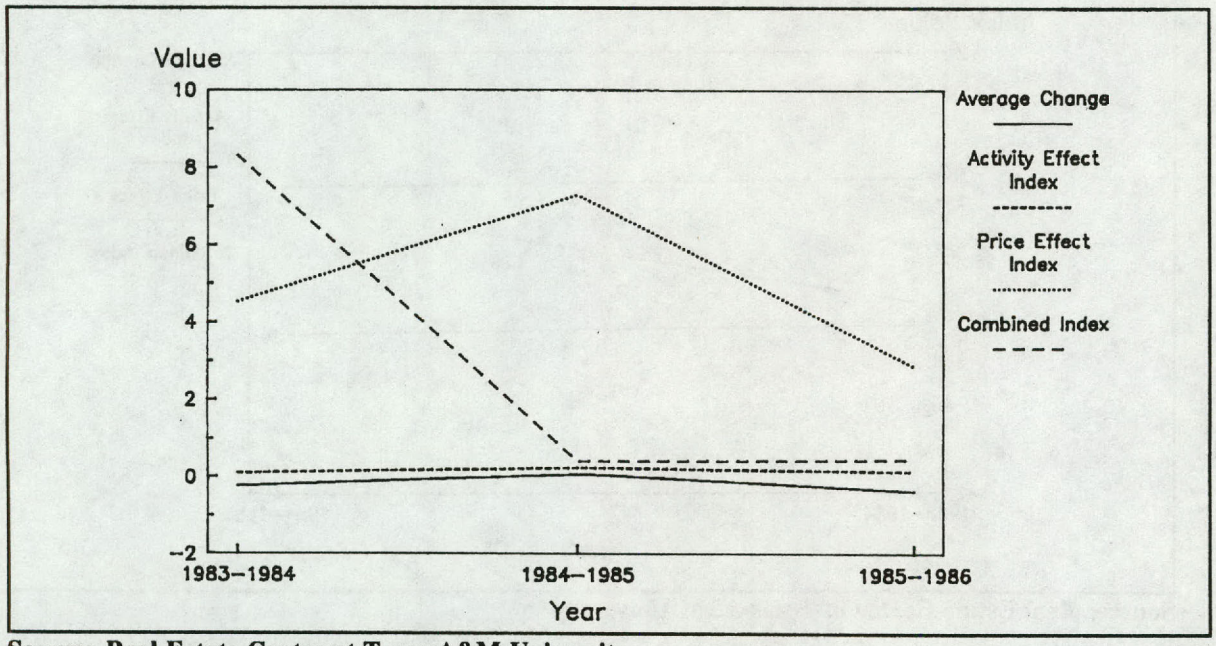
Source: Real Estate Center at Texas A&M University

Figure 1. Overall Austin Commercial Land Price Indices



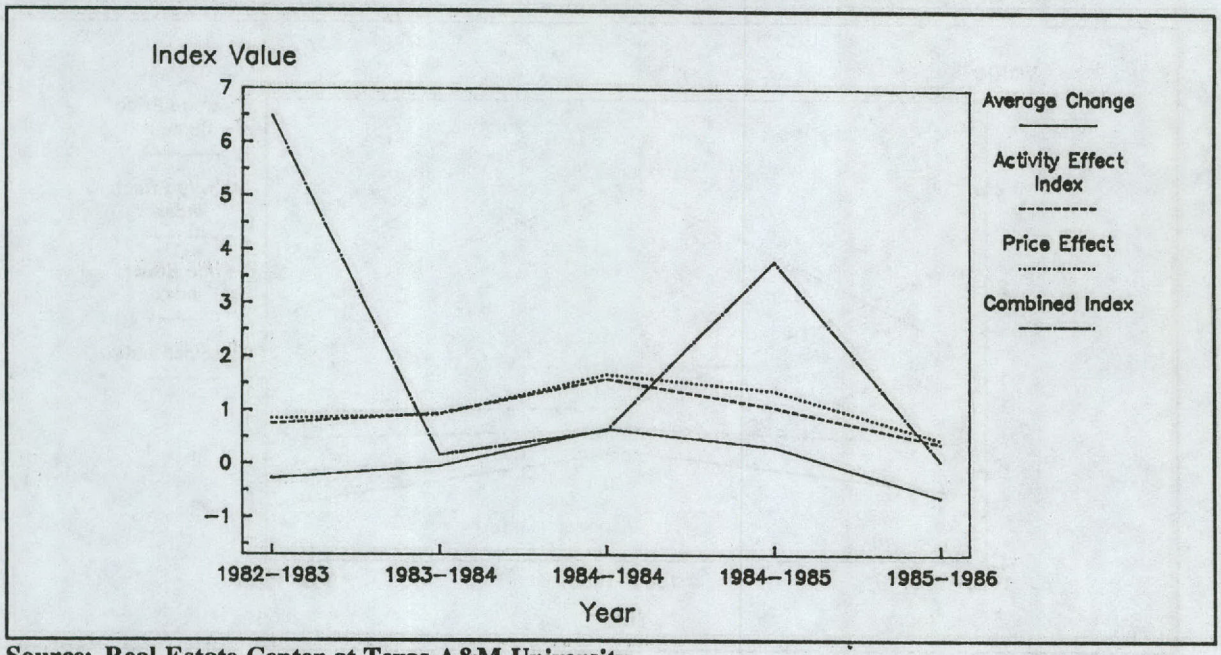
Source: Real Estate Center at Texas A&M University

Figure 2. Overall Austin Residential Land Price Indices



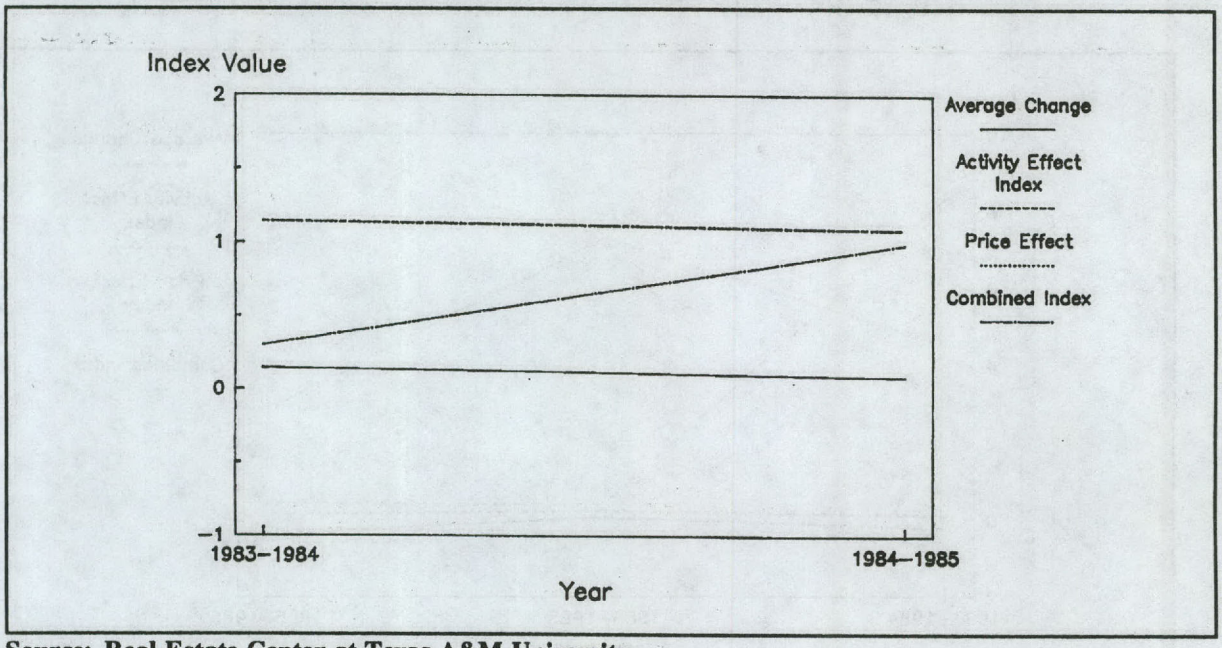
Source: Real Estate Center at Texas A&M University

Figure 3. Commercial Central Business District Land Price Indices



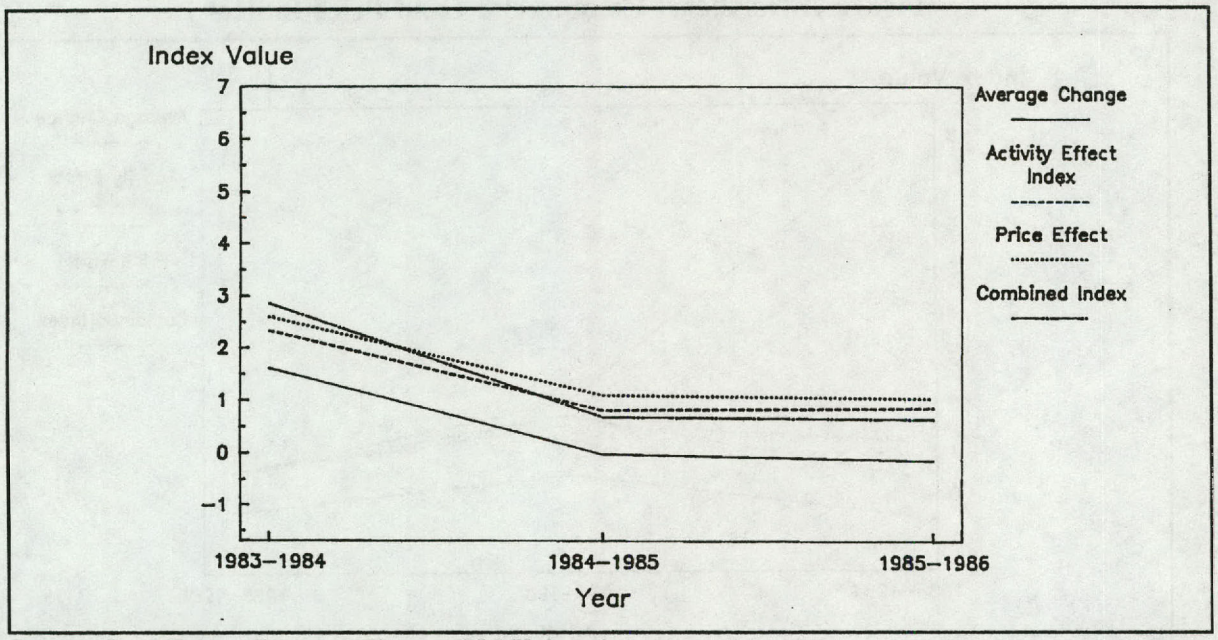
Source: Real Estate Center at Texas A&M University

Figure 4. Residential Central Business District Land Price Indices



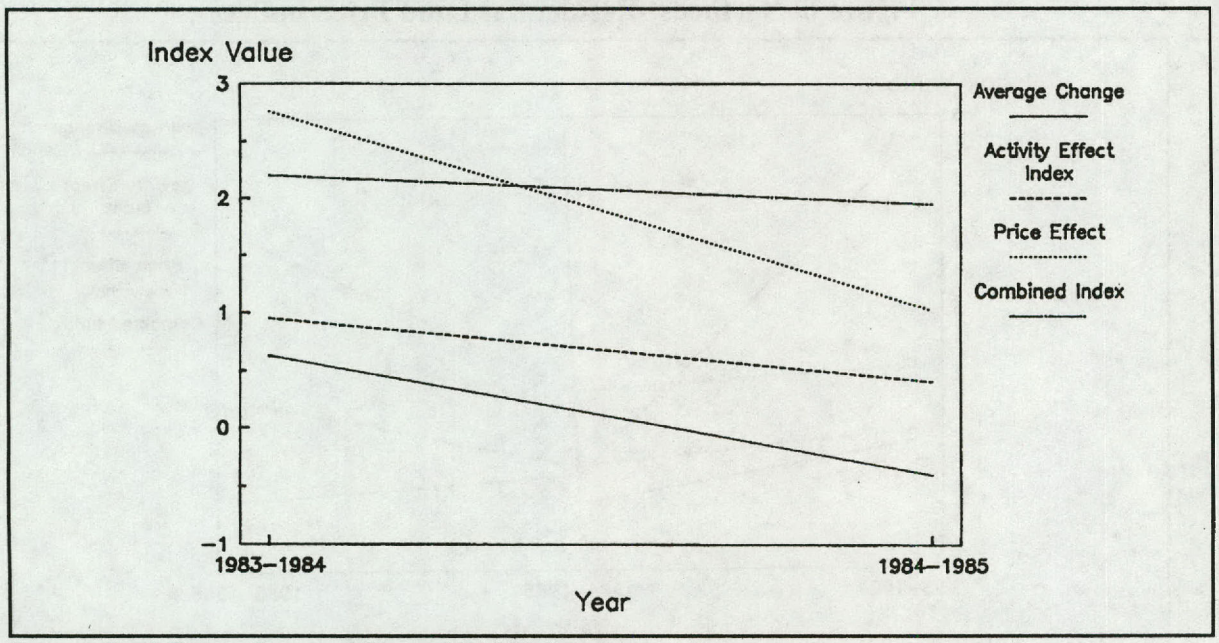
Source: Real Estate Center at Texas A&M University

Figure 5. South-Commercial Land Price Indices



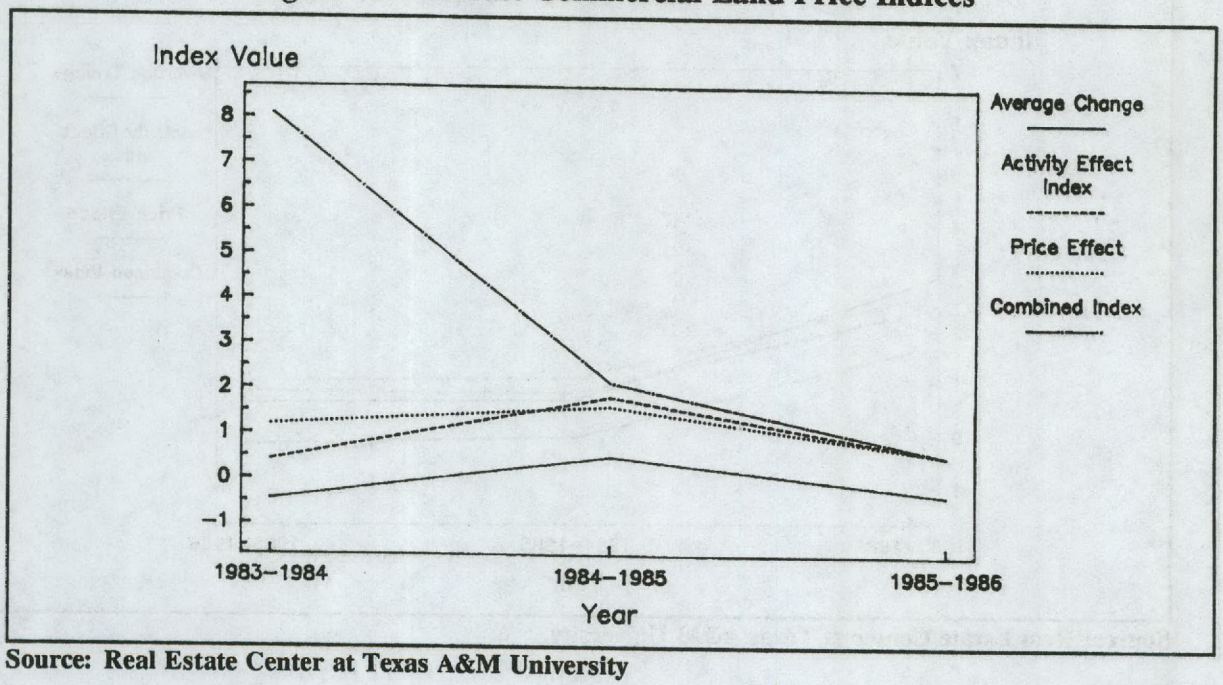
Source: Real Estate Center at Texas A&M University

Figure 6. South-Residential Land Price Indices



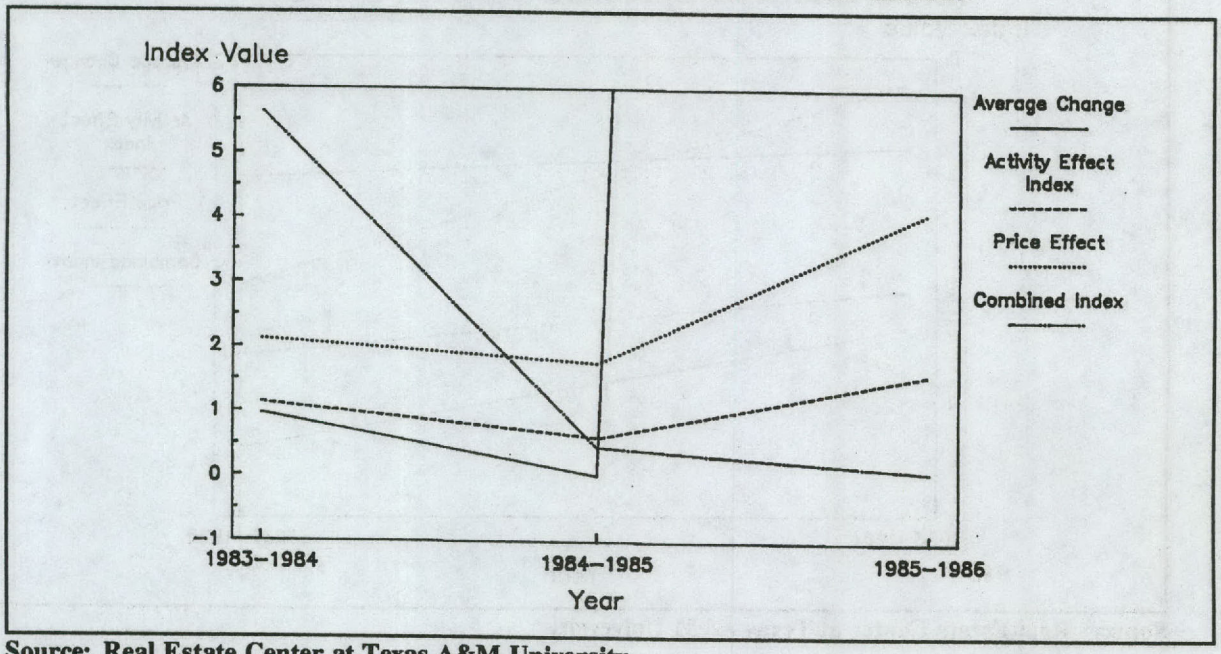
Source: Real Estate Center at Texas A&M University

Figure 7. Northeast-Commercial Land Price Indices



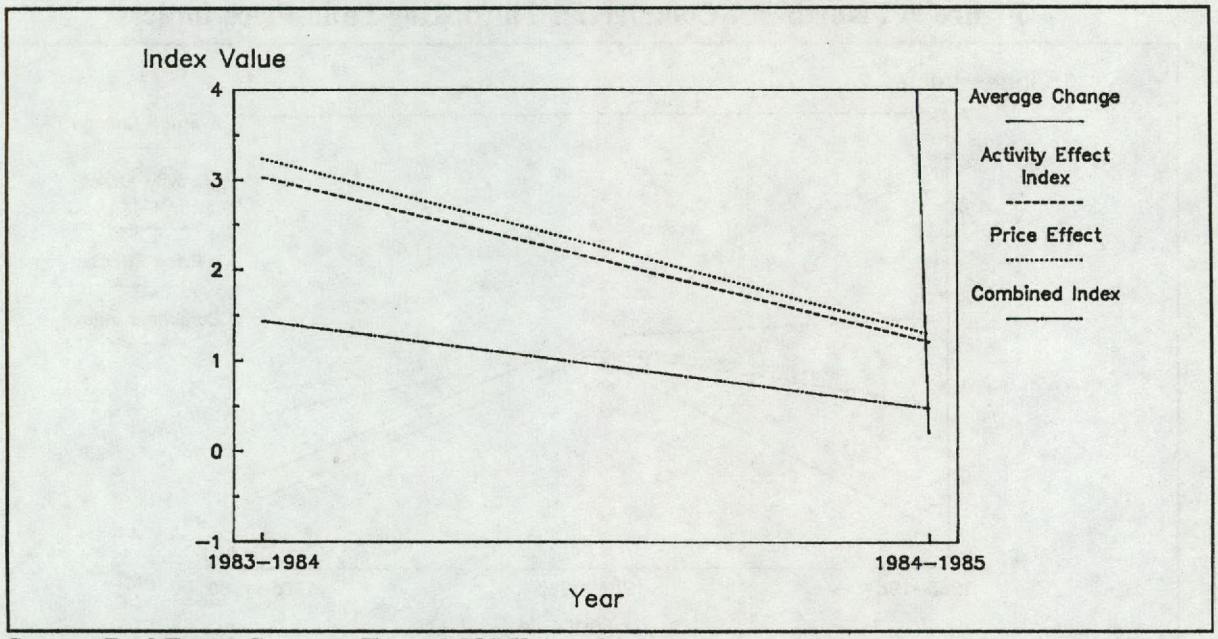
Source: Real Estate Center at Texas A&M University

Figure 8. Northeast-Residential Land Price Indices



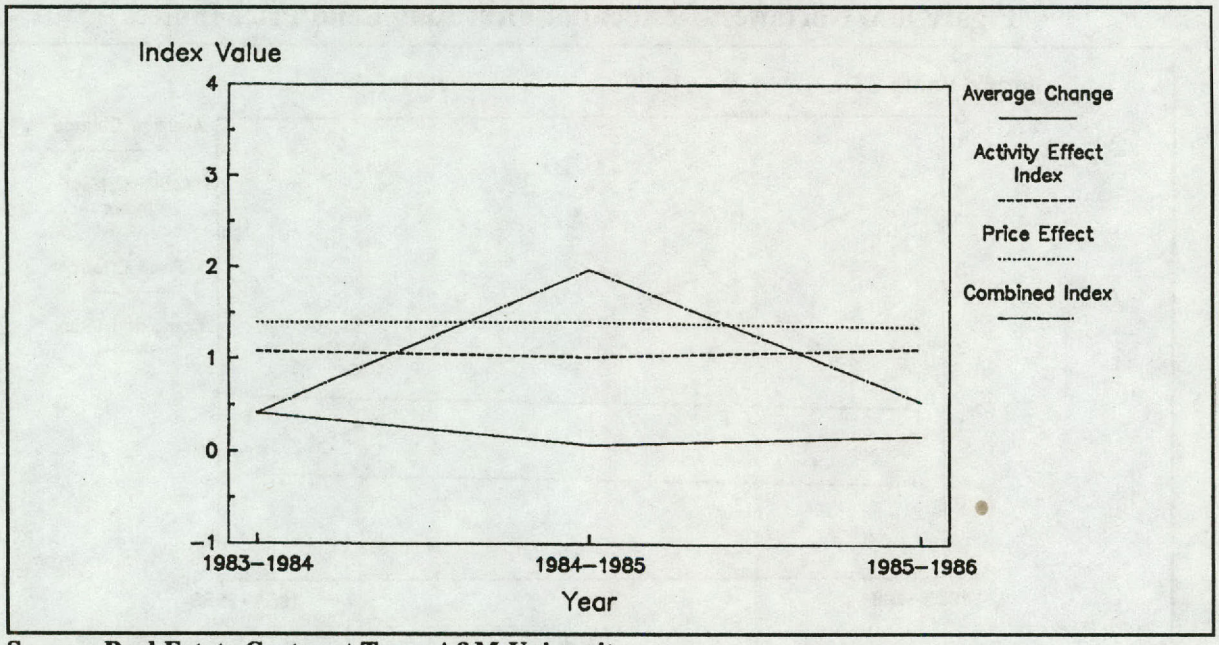
Source: Real Estate Center at Texas A&M University

Figure 9A. Northwest-Commercial First Ring Land Price Indices



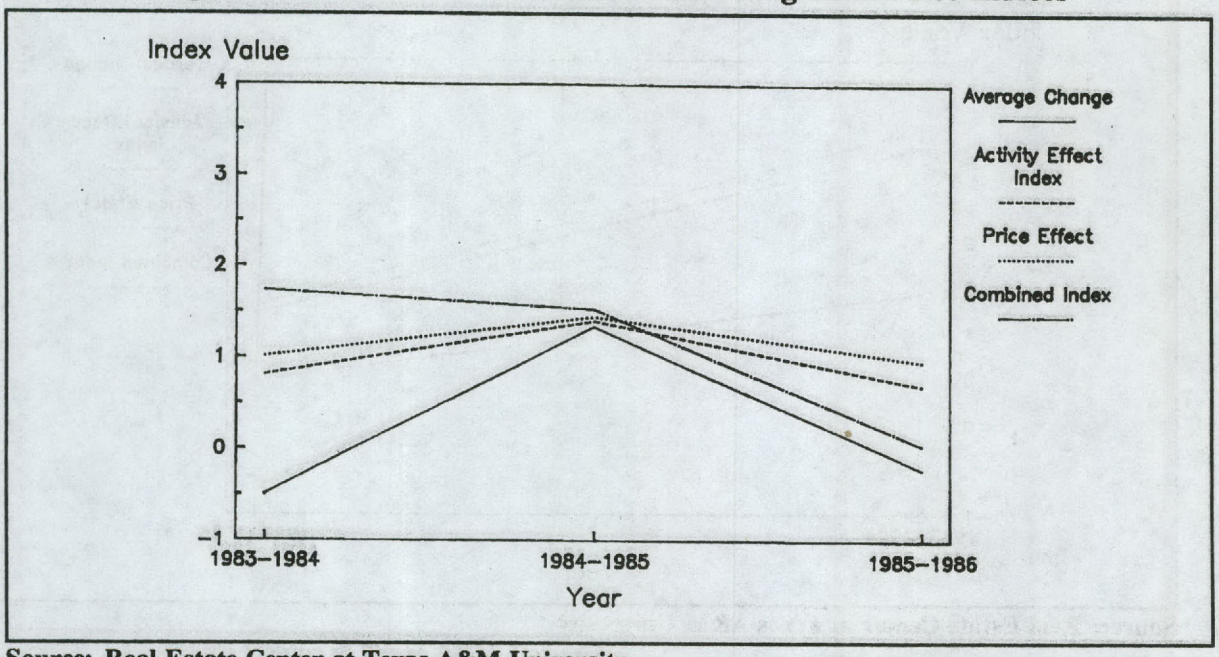
Source: Real Estate Center at Texas A&M University

Figure 9B. Northwest-Commercial Second Ring Land Price Indices



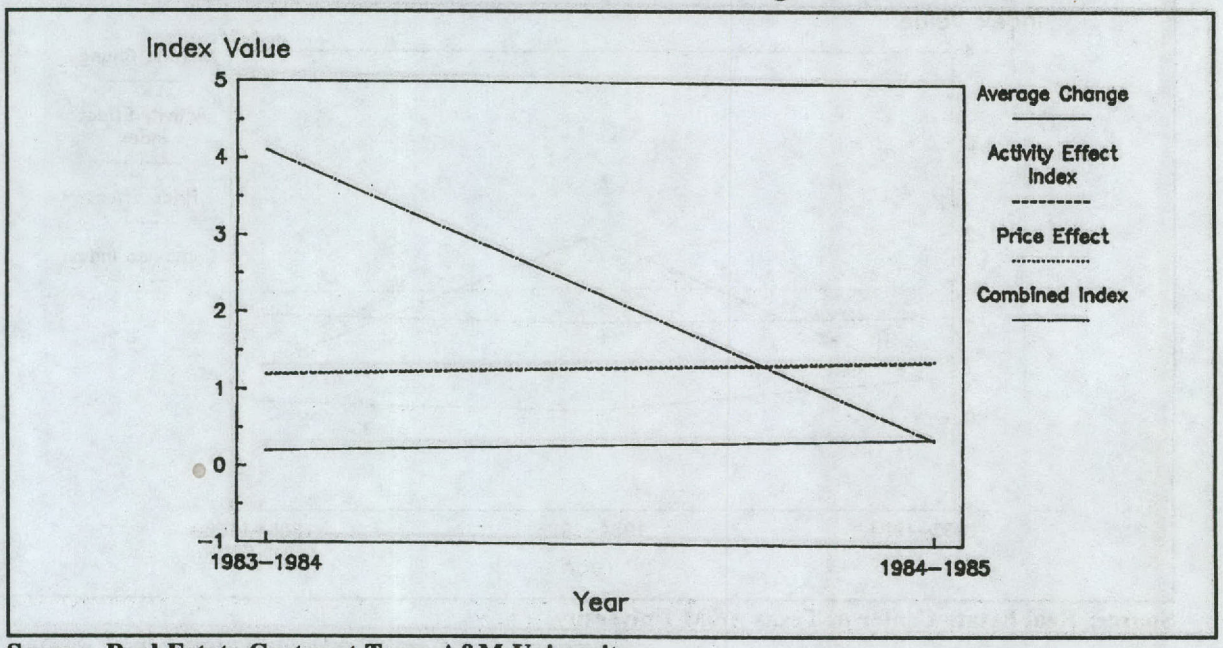
Source: Real Estate Center at Texas A&M University

Figure 9C. Northwest-Commercial Third Ring Land Price Indices



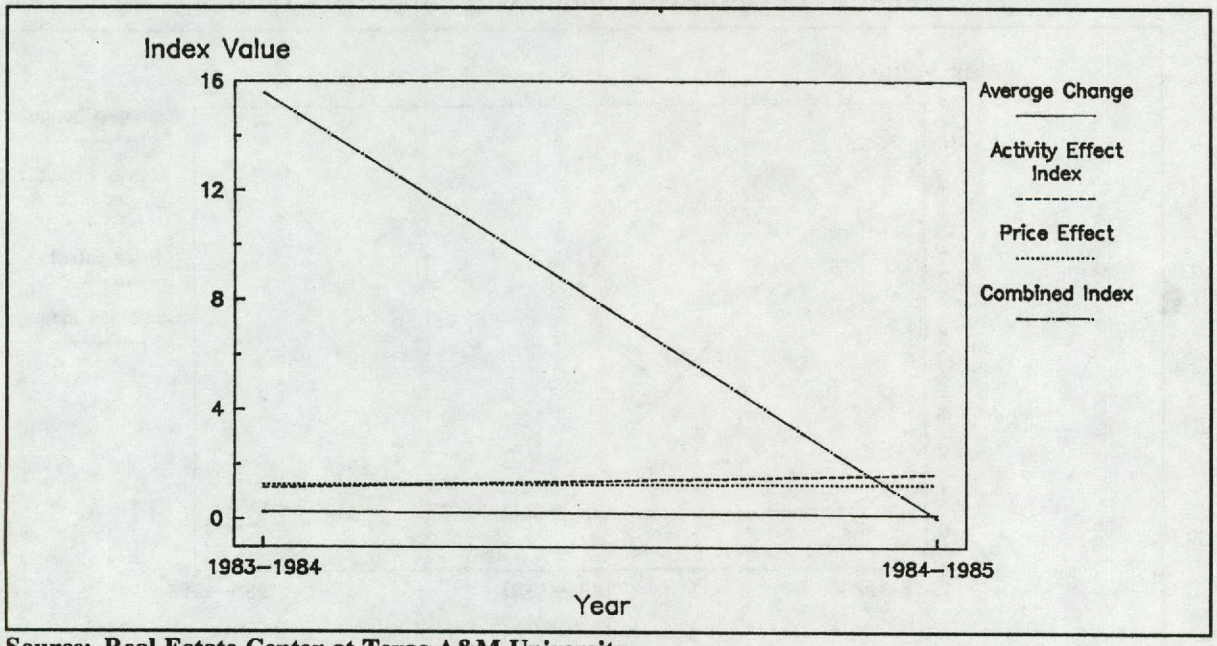
Source: Real Estate Center at Texas A&M University

Figure 10A. Northwest-Residential First Ring Land Price Indices



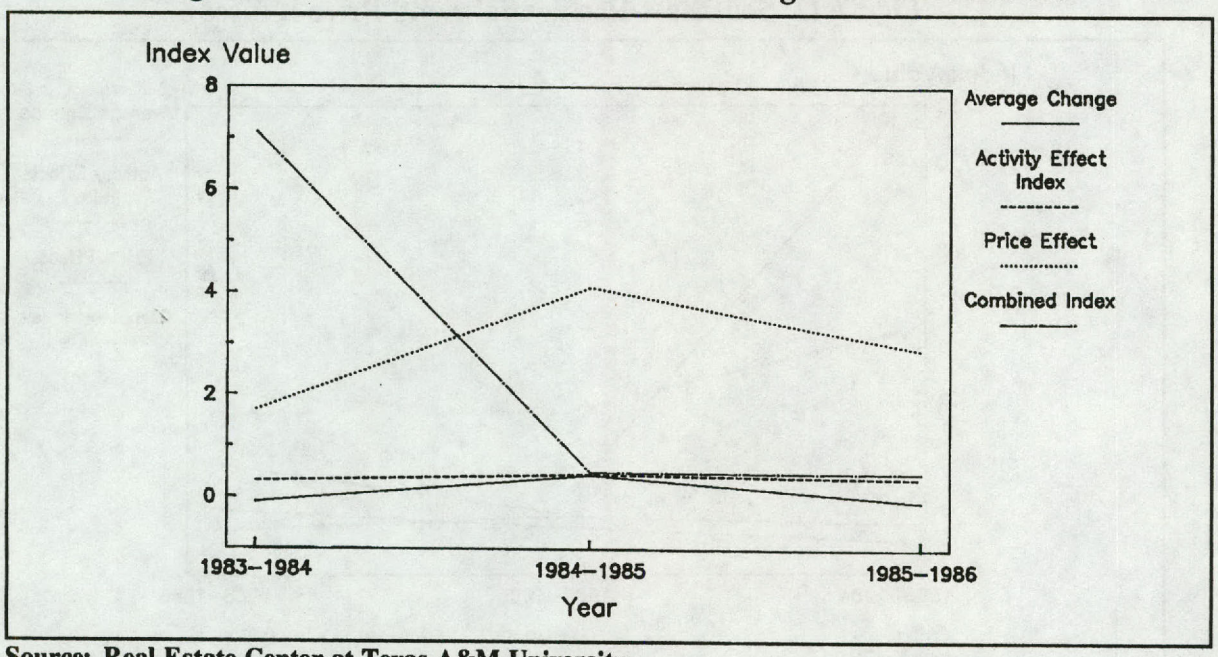
Source: Real Estate Center at Texas A&M University

Figure 10B. Northwest-Residential Second Ring Land Price Indices



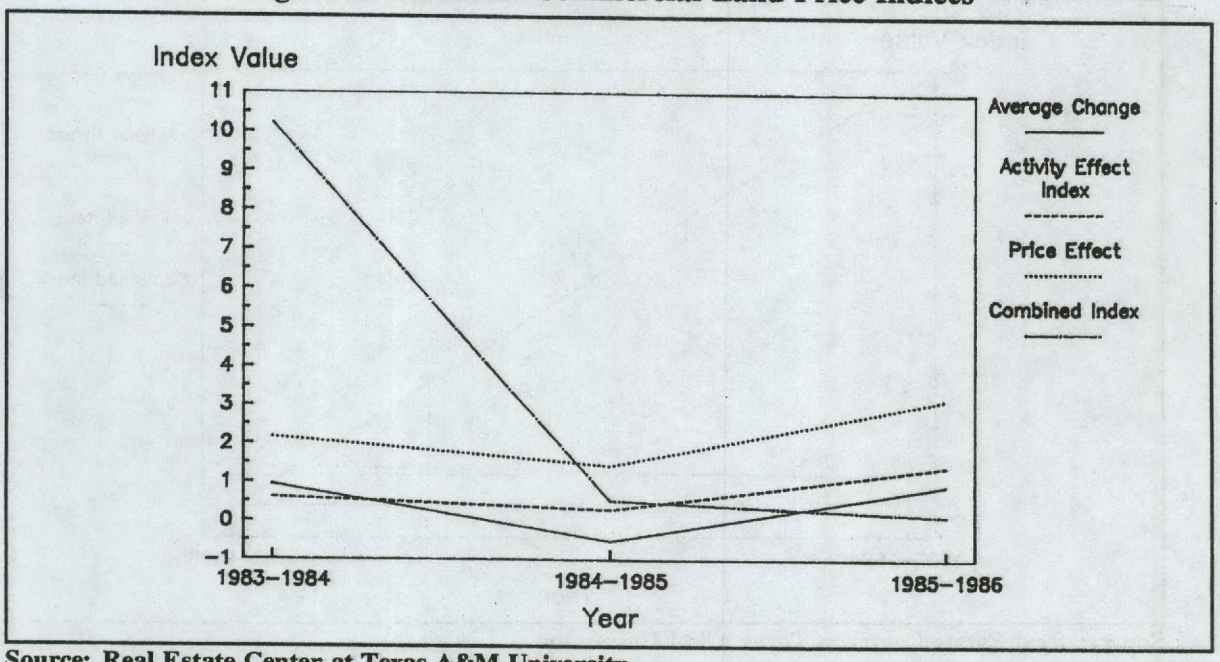
Source: Real Estate Center at Texas A&M University

Figure 10C. Northwest-Residential Third Ring Land Price Indices



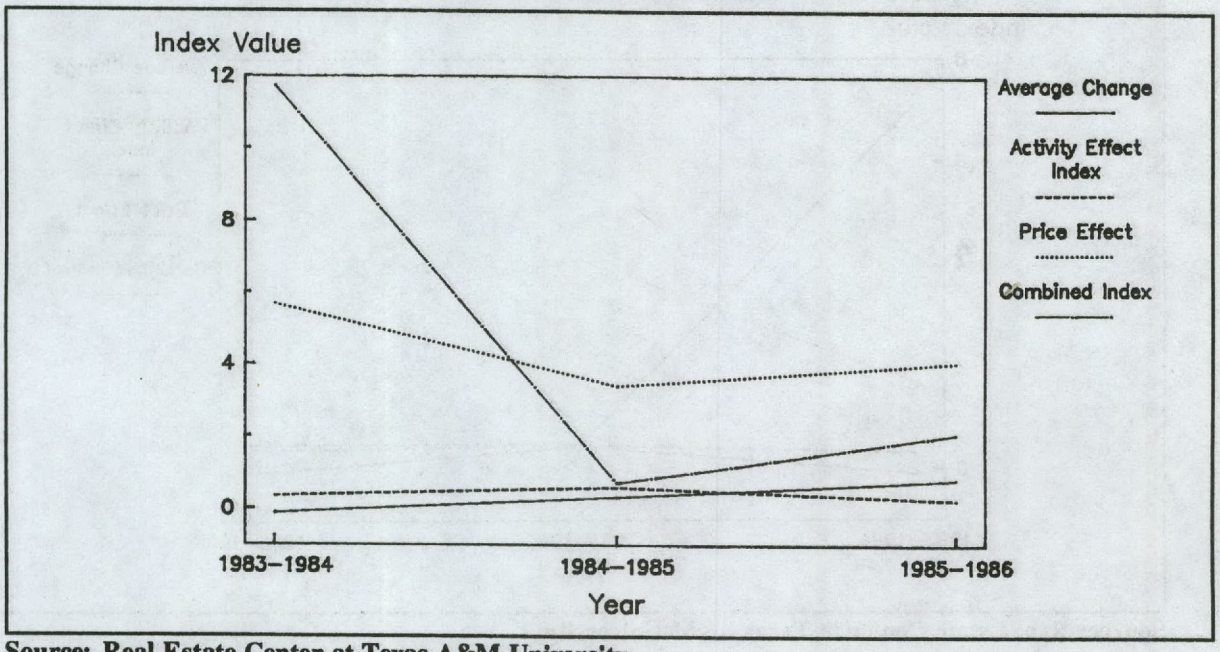
Source: Real Estate Center at Texas A&M University

Figure 11. Southeast-Commercial Land Price Indices



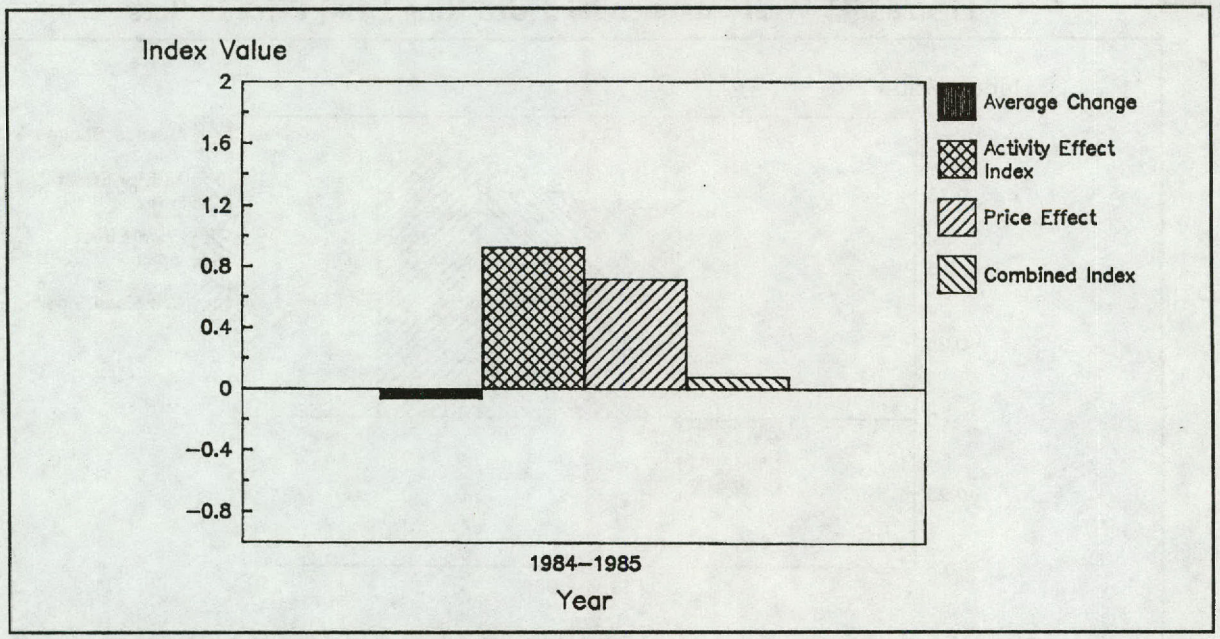
Source: Real Estate Center at Texas A&M University

Figure 12. Southeast-Residential Land Price Indices



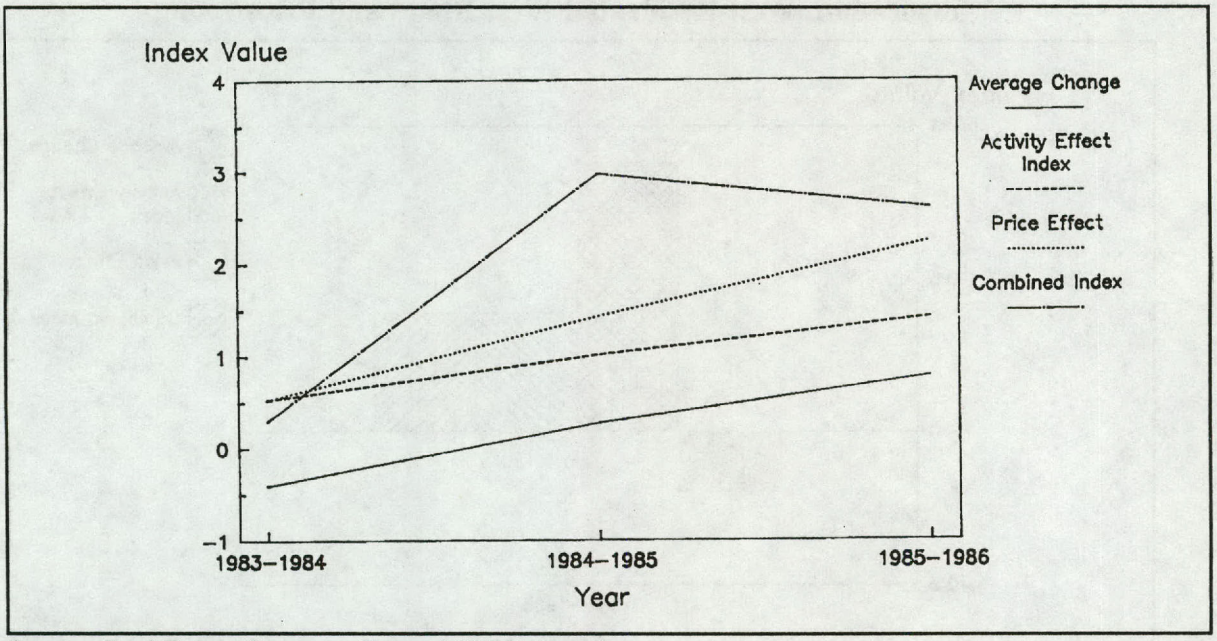
Source: Real Estate Center at Texas A&M University

Figure 13A. West-Commercial First Ring Land Price Indices



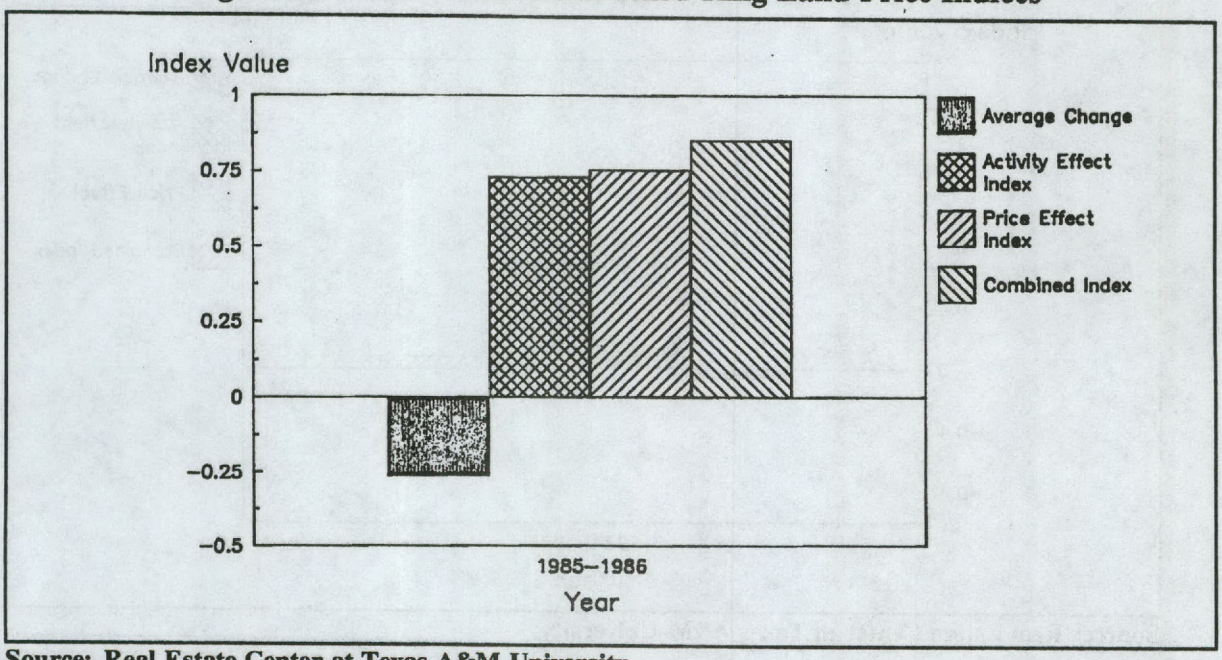
Source: Real Estate Center at Texas A&M University

Figure 13B. West-Commercial Second Ring Land Price Indices



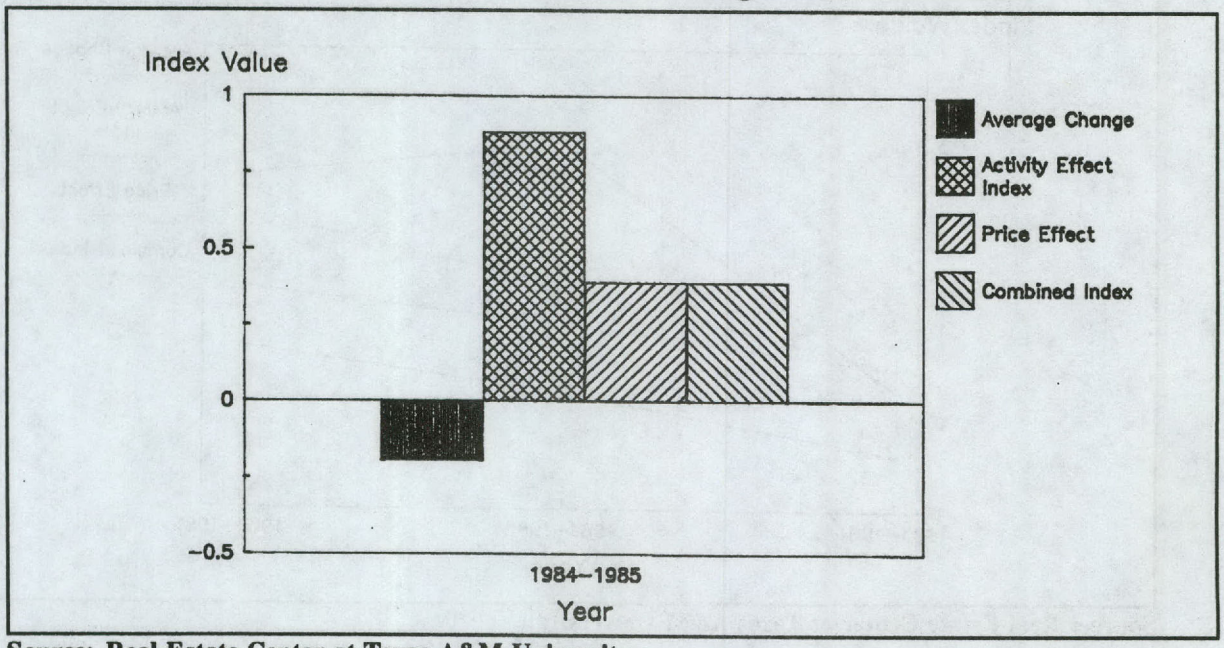
Source: Real Estate Center at Texas A&M University

Figure 13C. West-Commercial Third Ring Land Price Indices



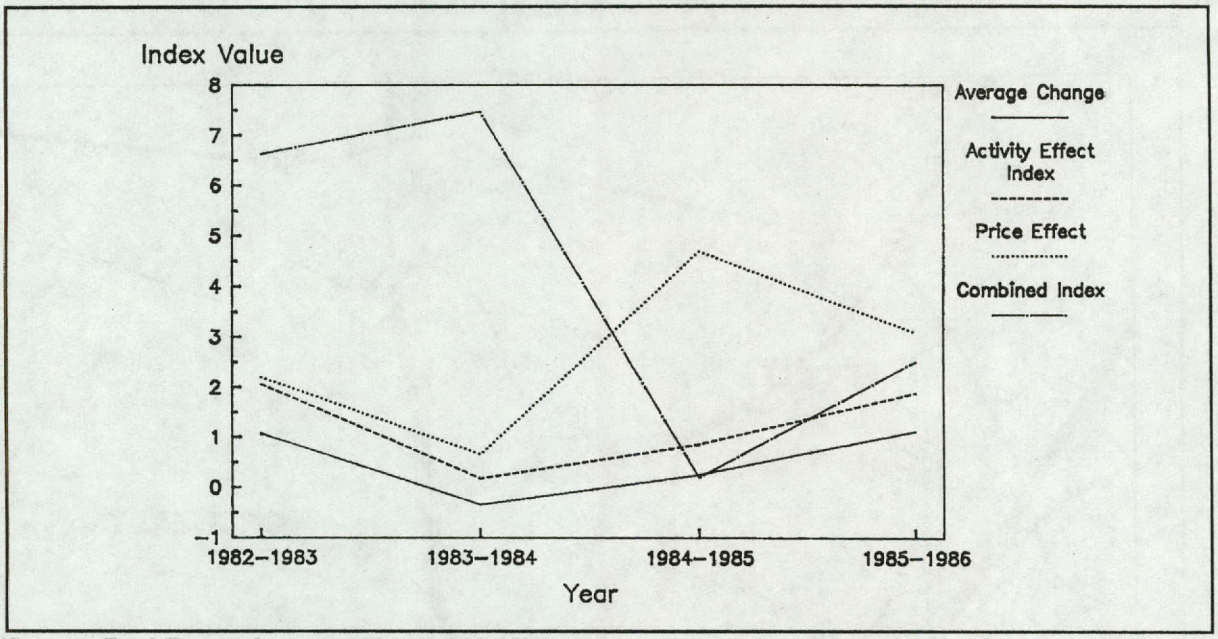
Source: Real Estate Center at Texas A&M University

Figure 14A. West-Residential First Ring Land Price Indices



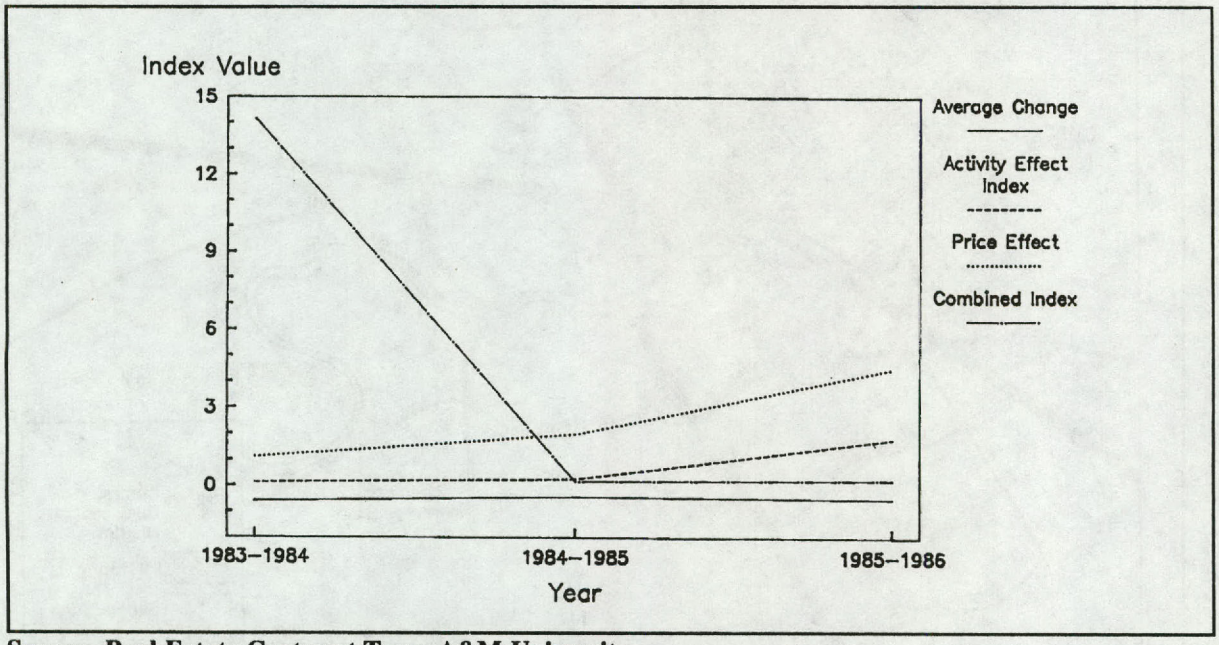
Source: Real Estate Center at Texas A&M University

Figure 14B. West-Residential Second Ring Land Price Indices



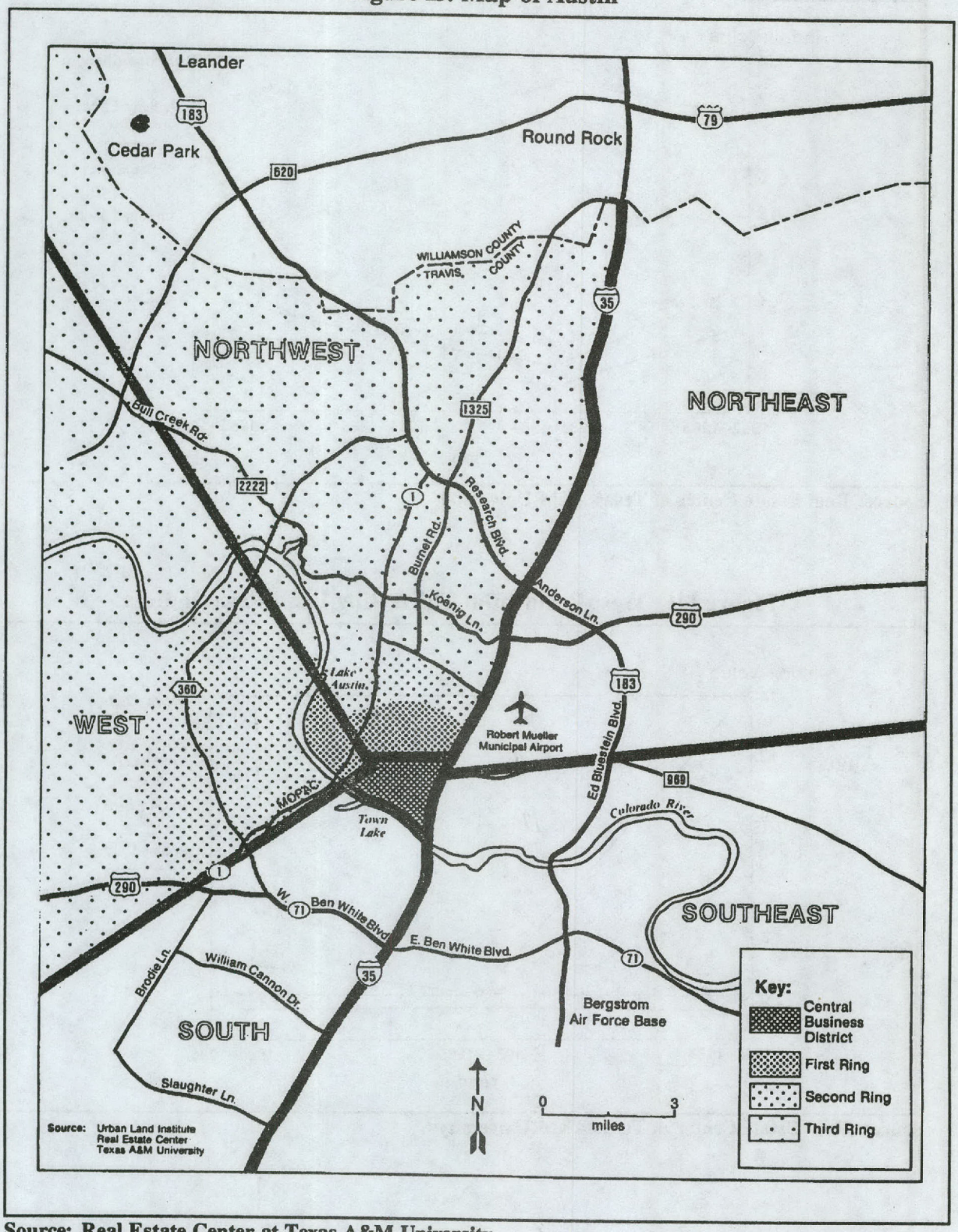
Source: Real Estate Center at Texas A&M University

Figure 14C. West-Residential Third Ring Land Price Indices



Source: Real Estate Center at Texas A&M University

Figure 15. Map of Austin



Source: Real Estate Center at Texas A&M University

Notes

[1]J. Thomas Black, ed. *Urban Land Markets: Price Indices, Supply Measures, and Public Policy Effects* (Washington, DC: The Urban Land Institute, 1980), p. vi.

[2]James A. Spinks, *Von Thunen's Bid-rent Curves: An Application to Austin,* unpublished master's professional report, (Austin, Texas: University of Texas, 1986), p. 15. This identifies two distinct markets. The findings of the Spinks report are reinforced by a geographical plotting of the data used to create the indices in this study.

[3]Black, p. 6.

[4]Black, p. 6. The activity index in this study is identified in the literature as a Paasche Index. See Appendix A.

[5]Black, p. 6. The activity index in this study is identified in the literature as a Laspeyre Index. See Appendix A.

[6]William Alonso, *Location and Land Use* (Cambridge, Massachusetts: Harvard University Press, 1964), p. 19.

[7]Black, p. 6.

[8]James Graaskamp, *A Guide to Feasibility Studies* (Chicago, Illinois: Society of Real Estate Appraisers, 1972), pp. 67-81.

[9]William Alonso, *Location and Land Use* (Cambridge, Massachusetts: Harvard University Press, 1964), pp. 76-100.

[10]Alfred Marshall, *Principles of Economics* (London, England: Macmillan Press, 1979), pp. 356-76.

[11]Richard B. Andrews, *Urban Land Economics and Public Policy* (New York City: Free Press, 1971), pp. 31-55.

[12]Thomas Black, ed. *Urban Land Markets: Price Indices, Supply Measures, and Public Policy Effects* (Washington, DC: The Urban Land Institute, 1980), p. 6.

[13]August Losch, *The Economics of Location* (New Haven, Connecticut: Yale University Press, 1978), p. 491.

[14]C.E. Ferguson, *Microeconomic Theory* (Homewood, Illinois: Richard D. Irwin, Inc., 1966), pp. 67-68.

[15]Losch, p. 491.

[16]The perspective of subjective weights is based on the series of papers in the Urban Land Institute publication edited by Black.

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